THE

CHEMISTS' YEAR BOOK

1920

EDITED BY

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VOLUME ONE

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PREFACE TO THE FIFTH EDITION (1920).

In the present edition, apart from the usual revisions of a general character, the "Dairy Products" section has been revised by Messrs. G. D. Elsdon, F.I.C., and A. D. Heywood, F.I.C., and the "Carbohydrates" section by Mr. F. Robinson, M.Sc.Tech., F.I.C.

The principal alteration is the complete revision of the "Physical Chemistry Constants" section, for the organisation of which the Editor is indebted to Dr. G. Barr, of the National Physical Laboratory.

The Editor is also indebted to numerous correspondents and also to several critical reviewers for valuable suggestions; although it has not proved possible to incorporate in the present edition all the improvements suggested, the Editor wishes to assure all correspondents that their comments have been carefully noted.

THE EDITOR.

34, Cross Street,
Manchester.
December, 1919.

PREFACE TO THE FIRST EDITION.

MANY chemists and other scientific workers have availed themsclves in the past of pocket-books issued annually in the German language. As the supply of German books is now cut off, the Editor has taken the favourable opportunity so offered to carry out a scheme to produce an annual pocket-book in the English Language. Every effort possible has been made to ensure the accuracy of the tables and other data given, and each year the book will be subjected to a careful revision in order to keep it as up-to-date and reliable as possible.

The Editor regrets that the difficulty experienced in setting up the numerous tables has made it impossible to complete for publication this year certain sections which it had been hoped to include.

In conclusion, the Editor wishes to express his indebtedness to those who have assisted in compiling this book, more particularly to Mr. L. Whinyates for constant assistance throughout its preparation.

THE EDITOR.

January, 1915.

CONTENTS OF VOLUME ONE.

ATOMIC WEIGHTS 1920.

Name.	Symbol.	O = 16.	H = 1.
Aluminium	Al	**27.1**	26.8
Antimony	Sb	**120.2**	119.3
Argon	A	**39.9**	39.6
Arsenic	As	**74.96**	74.37
Barium	Ba	**137.37**	136.27
Bismuth	Bi	**208.0**	206.3
Boron	B	**10.9**	10.8
Bromine	Br	**79.92**	79.29
Cadmium	Cd	**112.40**	111.51
Cæsium	Cs	**132.81**	131.76
Calcium	Ca	**40.07**	39.75
Carbon	C	**12.00**	11.91
Cerium	Ce	**140.25**	139.14
Chlorine	Cl	**35.46**	35.20
Chromium	Cr	**52.0**	51.6
Cobalt	Co	**58.97**	58.50
Columbium (*Niobium*)	Cb	**93.1**	92.4
Copper	Cu	**63.57**	63.06
Dysprosium	Dy	**162.5**	161.2
Erbium	Er	**167.7**	166.4
Europium	Eu	**152.0**	150.8
Fluorine	F	**19.0**	18.8
Gadolinium	Gd	**157.3**	156.1
Gallium	Ga	**70.1**	69.5
Germanium	Ge	**72.5**	71.9
Glucinum (*Beryllium*)	Gl	**9.1**	9.0
Gold	Au	**197.2**	195.6
Helium	He	**4.00**	3.97
Holmium	Ho	**163.5**	162.2
Hydrogen	H	**1.008**	1.00
Indium	In	**114.8**	113.9
Iodine	I	**126.92**	125.91
Iridium	Ir	**193.1**	191.6
Iron	Fe	**55.84**	55.40
Krypton	Kr	**82.92**	82.26
Lanthanum	La	**139.0**	137.9
Lead	Pb	**207.20**	205.56
Lithium	Li	**6.94**	6.88
Lutetium	Lu	**175.0**	173.6
Magnesium	Mg	**24.32**	24.13
Manganese	Mn	**54.93**	54.49

Name.	Symbol.	O=16	H=1.
Mercury	Hg	**200.6**	199.0
Molybdenum	Mo	**96.0**	95.2
Neodymium	Nd	**144.3**	143.2
Neon	Ne	**20.2**	20.0
Nickel	Ni	**58.68**	58.21
Niton (radium emanation)	Nt	**222.4**	220.6
Nitrogen	N	**14.008**	13.897
Osmium	Os	**190.9**	189.4
Oxygen	O	**16.00**	15.87
Palladium	Pd	**106.7**	105.9
Phosphorus	P	**31.04**	30.79
Platinum	Pt	**195.2**	193.7
Potassium	K	**39.10**	38.81
Praseodymium	Pr	**140.9**	139.8
Radium	Ra	**226.0**	224.2
Rhodium	Rh	**102.9**	102.1
Rubidium	Rb	**85.45**	84.77
Ruthenium	Ru	**101.7**	100.9
Samarium	Sa	**150.4**	149.2
Scandium	Sc	**44.1**	43.8
Selenium	Se	**79.2**	78.6
Silicon	Si	**28.3**	28.1
Silver	Ag	**107.88**	107.02
Sodium	Na	**23.00**	22.82
Strontium	Sr	**87.63**	86.93
Sulphur	S	**32.06**	31.86
Tantalum	Ta	**181.5**	180.1
Tellurium	Te	**127.5**	126.5
Terbium	Tb	**159.2**	157.9
Thallium	Tl	**204.0**	202.4
Thorium	Th	**232.15**	230.31
Thulium	Tu	**168.5**	167.2
Tin	Sn	**118.7**	117.8
Titanium	Ti	**48.1**	47.7
Tungsten	W	**184.0**	182.5
Uranium	U	**238.2**	236.3
Vanadium	V	**51.0**	50.6
Xenon	X	**130.2**	129.2
Ytterbium	Yb	**173.5**	172.1
Yttrium	Yt	**89.33**	88.60
Zinc	Zn	**65.37**	64.85
Zirconium	Zr	**90.6**	89.9

Multiples of the Atomic Weights and their Logarithms.

(Calculated from Atomic Weights, 1920.)

	1	2	3	4	5	6	7	8	9	10	
	0.00000	.30103	.47712	.60206	.69897	.77815	.84510	.90309	.95424	1.00000	Log.
Aluminium ....Al	27.1	54.2	81.3	108.4	135.5	162.6	189.7	216.8	243.9	271	1.43297
Antimony ....Sb	120.2	240.4	360.6	480.8	601	721.2	841.4	961.6	1081.8	1202	2.07990
Arsenic ....As	74.96	149.92	224.88	299.84	374.8	449.76	524.72	599.68	674.64	749.6	1.87483
Barium ....Ba	137.37	274.74	412.11	549.48	686.85	824.22	961.59	1098.96	1236.33	1373.7	2.13789
Bismuth ....Bi	208	416	624	832	1040	1248	1456	1664	1872	2080	2.31806
Boron ....B	10.9	21.8	32.7	43.6	54.5	65.4	76.3	87.2	98.1	109	1.03743
Bromine ....Br	79.92	159.84	239.76	319.68	399.6	479.52	559.44	639.36	719.28	799.2	1.90266
Cadmium ....Cd	112.4	224.8	337.2	449.6	562	674.4	786.8	899.2	1011.6	1124	2.05077
Cæsium ....Cs	132.81	265.62	398.43	531.24	664.05	796.86	929.67	1062.48	1195.29	1328.0	2.12323
Calcium ....Ca	40.07	80.14	120.21	160.28	200.35	240.42	280.49	320.56	360.63	400.7	1.60282
Carbon C	12.00	24.00	36.00	48.00	60.00	72.00	84.00	96.00	108.00	120.0	1.07918
Cerium ....Ce	140.25	280.5	420.75	561	701.25	841.5	981.75	1122	1262.25	1402.5	2.14690
Chlorine Cl	35.46	70.92	106.38	141.84	177.30	212.76	248.22	283.68	319.14	354.6	1.54974
Chromium ....Cr	52	104	156	208	260	312	364	416	468	520	1.71600
Cobalt ....Co	58.97	117.94	176.91	235.88	294.85	353.82	412.79	471.76	530.73	589.7	1.77063
Columbium ......Cb	93.1	186.2	279.3	372.4	465.5	558.6	651.7	744.8	837.9	931.0	1.96895
Copper .. ..Cu	63.57	127.14	190.71	254.28	317.85	381.42	444.99	508.56	572.13	635.7	1.80325
Erbium ....Er	167.7	335.4	503.1	670.8	838.5	1006.2	1173.9	1341.6	1509.3	1677	2.22453
Fluorine ....F	19	38	57	76	95	114	133	152	171	190	1.27875
Gallium ....Ga	70.1	140.2	210.3	280.4	350.5	420.6	490.7	560.8	630.9	701	1.84572
Germanium ......Ge	72.5	145	217.5	290	362.5	435	507.5	580	652.5	725	1.86034

	1	2	3	4	5	6	7	8	9	10	
	0.00000	.30103	.47712	.60206	.69897	.77815	.84510	.90309	.95424	1.00000	Log.
Glucinum ...... Gl	9.1	18.2	27.3	36.4	45.5	54.6	63.7	72.8	81.9	91.0	0.95904
Gold ....Au	197.2	394.4	591.6	788.8	986	1183.2	1380.4	1577.6	1774.8	1972	2.29491
Hydrogen ....H	1.008	2.016	3.024	4.032	5.04	6.048	7.056	8.064	9.072	10.08	0.00346
Indium ....In	114.8	229.6	344.4	459.2	574	688.8	803.6	918.4	1033.2	1148	2.05994
Iodine I	126.92	253.84	380.76	507.68	634.6	761.52	888.44	1015.36	1142.28	1269.2	2.10353
Iridium ....Ir	193.1	386.2	579.3	772.4	965.5	1158.6	1351.7	1544.8	1737.9	1931	2.28578
Iron ....Fe	55.84	111.68	167.52	223.36	279.2	335.04	390.88	446.72	502.56	558.4	1.74695
Lanthanum ......La	139	278	417	556	695	834	973	1112	1251	1390	2.14301
Lead ....Pb	207.2	414.4	621.6	828.8	1036.0	1243.2	1450.4	1657.6	1864.8	2072	2.31639
Lithium Li	6.94	13.88	20.82	27.76	34.7	41.64	48.58	55.52	62.46	69.4	0.84136
Magnesium ......Mg	24.32	48.64	72.96	97.28	121.6	145.92	170.24	194.56	218.88	243.2	1.38596
Manganese ......Mn	54.93	109.86	164.79	219.72	274.65	329.58	384.51	439.44	494.37	549.3	1.73981
Mercury ....Hg	200.6	401.2	601.8	802.4	1003	1203.6	1404.2	1604.8	1805.4	2006	2.30233
Molybdenum ....Mo	96	192	288	384	480	576	672	768	864	960	1.98227
Nickel ....Ni	58.68	117.36	176.04	234.72	293.4	352.08	410.76	469.44	528.12	586.8	1.76849
Nitrogen ....N	14.008	28.016	42.024	56.032	70.040	84.048	98.056	112.064	126.072	140.08	1.14638
Osmium ....Os	190.9	381.8	572.7	763.6	954.5	1145.4	1336.3	1527.2	1718.1	1909	2.28081
Oxygen ....O	16	32	48	64	80	96	112	128	144	160	1.20412
Palladium ....Pd	106.7	213.4	320.1	426.8	533.5	640.2	746.9	853.6	960.3	1067	2.02816
Phosphorus ....P	31.04	62.08	93.12	124.16	155.20	186.24	217.28	248.32	279.36	310.4	1.49192
Platinum ....Pt	195.2	390.4	585.6	780.8	976	1171.2	1366.4	1561.6	1756.8	1952	2.29048
Potassium ....K	39.1	78.2	117.3	156.4	195.5	234.6	273.7	312.8	351.9	391	1.59218
Rhodium ....Rh	102.9	205.8	308.7	411.6	514.5	617.4	720.3	823.2	926.1	1029	2.01242

	1	2	3	4	5	6	7	8	9	10	
	0.00000	.30103	.47712	.60206	.69897	.77815	.84510	.90309	.95424	1.00000	Log.
Rubidium ....Rb	85.45	170.9	256.35	341.8	427.25	512.7	598.15	683.6	769.05	854.5	1.93171
Ruthenium ......Ru	101.7	203.4	305.1	406.8	508.5	610.2	711.9	813.6	915.3	1017	2.00732
Samarium ....Sa	150.4	300.8	451.2	601.6	752	902.4	1052.8	1203.2	1353.6	1504	2.17725
Scandium ....Sc	44.1	88.2	132.3	176.4	220.5	264.6	308.7	352.8	396.9	441	1.64444
Selenium ....Se	79.2	158.4	237.6	316.8	396	475.2	554.4	633.6	712.8	792	1.89873
Silicon ....Si	28.3	56.6	84.9	113.2	141.5	169.8	198.1	226.4	254.7	283	1.45179
Silver ....Ag	107.88	215.76	323.64	431.52	539.4	647.28	755.16	863.04	970.92	1078.8	2.03294
Sodium ....Na	23	46	69	92	115	138	161	184	207	230	1.36173
Strontium ....Sr	87.63	175.26	262.89	350.52	438.15	525.78	613.41	701.04	788.67	876.3	1.94265
Sulphur ....S	32.06	64.12	96.18	128.24	160.30	192.36	224.42	256.48	288.54	320.6	1.50696
Tantalum ....Ta	181.5	363	544.5	726	907.5	1089	1270.5	1452	1633.5	1815	2.25888
Tellurium ....Te	127.5	255	382.5	510	637.5	765	892.5	1020	1147.5	1275	2.10551
Thallium ....Tl	204	408	612	816	1020	1224	1428	1632	1836	2040	2.30963
Thorium ....Th	232.15	464.30	696.45	928.60	1160.75	1392.90	1625.05	1857.20	2089.35	2321.5	2.36577
Tin ....Sn	118.7	237.4	356.1	474.8	593.5	712.2	830.9	949.6	1068.3	1187	2.07445
Titanium ....Ti	48.1	96.2	144.3	192.4	240.5	288.6	336.7	384.8	432.9	481	1.68215
Tungsten ....W	184	368	552	736	920	1104	1288	1472	1656	1840	2.26482
Uranium ....U	238.2	476.4	714.6	952.8	1191.0	1429.2	1667.4	1905.6	2143.8	2382	2.37694
Vanadium V	51	102	153	204	255	306	357	408	459	510	1.70757
Ytterbium ....Yb	173.5	347	520.5	694	867.5	1041	1214.5	1388	1561.5	1735	2.23930
Yttrium ....Y	89.33	178.66	267.99	357.32	446.65	535.98	625.31	714.64	803.97	893.3	1.95085
Zinc ....Zn	65.37	130.74	196.11	261.48	326.85	392.22	457.59	522.96	588.33	653.7	1.81538
Zirconium ....Zr	90.6	181.2	271.8	362.4	453	543.6	634.2	724.8	815.4	906	1.95713

		11	12	13	14	15	16	17	18	19	20	
		1.04139	1.07918	1.11394	1.14613	1.17609	1.20412	1.23045	1.25527	1.27875	1.30103	Log.
Carbon	C	132.00	144.00	156.00	168.00	180 00	192.00	204.00	216.00	228.00	240.00	1.07918
Chlorine	Cl	390.06	425.52	460.98	496.44	531.90	567.36	602.82	638.28	673.74	709.20	1.54974
Hydrogen	H	11.088	12.096	13.104	14.112	15.12	16.128	17.136	18.144	19.152	20.16	0.00346
Nitrogen	N	154.098	168.096	182.104	196.112	210.120	224.128	238.136	252.144	266.152	280.16	1.14638
Oxygen	O	176	192	208	224	240	256	272	288	304	320	1.20412
Silicon	Si	311.3	339.6	367.9	396.2	424.5	452.8	481.1	509.4	537.7	566	1.45179

		21	22	23	24	25	26	27	28	29	30	
		1.32222	1.34242	1.36173	1.38021	1.39794	1.41497	1.43136	1.44716	1.46240	1.47712	Log.
Carbon	C	252.00	264.00	276.00	288.00	300.00	312.00	324.00	336.00	348.00	360.00	1.07918
Hydrogen	H	21.168	22.176	23.184	24.192	25.2	26.208	27.216	28.224	29.232	30.24	0.00346
Oxygen	O	336	352	368	384	400	416	432	448	464	480	1.20412

		31	32	33	34	35	36	37	38	39	40	
		1.49136	1.50515	1.51851	1.53148	1.54407	1.55630	1.56820	1.57978	1.59106	1.60206	Log.
Carbon	C	372.00	384.00	396.00	408.00	420.00	432.00	444.00	456.00	468.00	480.00	1.07918
Hydrogen	H	31.248	32.256	33.264	34.272	35.28	36.288	37.296	38.304	39.312	40.32	0.00346

		41	42	43	44	45	46	47	48	49	50	
		1.61278	1.62325	1.63347	1.64345	1.65321	1.66276	1.67210	1.68124	1.69020	1.69897	Log.
Carbon	C	492.00	504.00	516.00	528.00	540.00	552.00	564.00	576.00	588.00	600.00	1.07918
Hydrogen	H	41.328	42.336	43.344	44.352	45.36	46.368	47.376	48.384	49.392	50.4	0.00346

Formula Weights of Certain Radicals and their Multiples.

Radical	Formula	1	2	3	4	5	6		8	9	10	
		0.00000	.30103	.47712	.60206	.69897	.77815	.84510	.90309	.95424	1.00000	Log.
Amino	NH_2	16.024	32.048	48.072	64.096	80.120	96.144	112.168	128.192	144.216	160.240	1.20477
Ammonium..	NH_4	18.040	36.080	54.120	72.160	90.200	108.240	126.280	144.320	162.360	180.400	1.25624
Carbonate ..	CO_3	60.00	120.00	180.00	240.00	300.00	360.00	420.00	480.00	540.00	600.00	1.77815
Carbonyl	CO	28.00	56.00	84.00	112.00	140.00	168.00	196.00	224.00	252.00	280.00	1.44716
Carboxyl ..	COOH	45.01	90.02	135.02	180.03	225.04	270.05	315.06	360.06	405.07	450.08	1.65331
Ethyl	C_2H_5	29.04	58.08	87.12	116.16	145.20	174.24	203.28	232.32	261.36	290.40	1.46300
Hydroxyl ..	OH	17.01	34.02	51.02	68.03	85.04	102.05	119.06	136.06	153.07	170.08	1.23065
Methyl	CH_3	15.02	30.05	45.07	60.10	75.12	90.14	105.17	120.19	135.22	150.24	1.17679
Naphthyl ..	$C_{10}H_7$	127.06	254.11	381.17	508.22	635.28	762.34	889.39	1016.45	1143.50	1270.56	2.10399
Nitrate	NO_3	62.01	124.02	186.02	248.03	310.04	372.05	434.06	496.06	558.07	620.08	1.79245
Nitro	NO_2	46.01	92.02	138.02	184.03	230.04	276.05	322.06	368.06	414.07	460.08	1.66284
Phenyl	C_6H_5	77.04	154.08	231.12	308.16	385.20	462.24	539.28	616.32	693.36	770.40	1.88672
Phenylene ..	C_6H_4	76.03	152.06	228.10	304.13	380.16	456.19	532.22	608.26	684.29	760.32	1.88099
Sulphate ..	SO_4	96.06	192.12	288.18	384.24	480.30	576.36	672.42	768.48	864.54	960.60	1.98254
Sulphonic ..	SO_3H	81.07	162.14	243.20	324.27	405.34	486.40	567.48	648.54	729.61	810.68	1.90886
Water	H_2O	18.02	36.03	54.05	72.06	90.08	108.10	126.11	144.13	162.14	180.16	1.25565

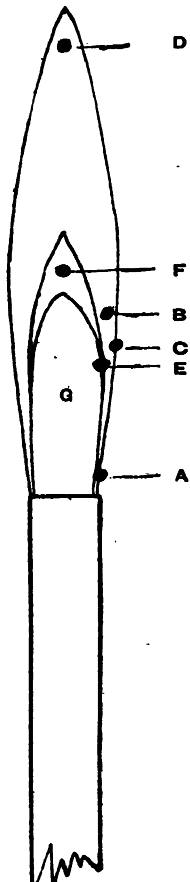
Periodic System of Mendeleeff.

Group	O.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.
Volatile Hydrogen compounds					MH_4	MH_3	MH_2	MH	
Highest salt-forming oxides		M_2O	MO	M_2O_3	MO_2	M_2O_5	MO_3	M_2O_7	MO_4
Series 1		H 1·008							
,, 2	He 4·00	Li 6·94	Gl 9·1	B 10·9	C 12·00	N 14·008	O 16·00	F 19·0	
,, 3	Ne 20·2	Na 23·00	Mg 24·32	Al 27·1	Si 28·3	P 31·04	S 32·06	Cl 35·46	
,, 4	A 39·9	K 39·10	Ca 40·07	Sc 44·1	Ti 48·1	V 51·0	Cr 52·0	Mn 54·93	Fe 55·84 Co 58·97 Ni 58·68
,, 5		Cu 63·57	Zn 65·37	Ga 70·1	Ge 72·5	As 74·96	Se 79·2	Br 79·92	

	O.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.		
Series 6	Kr 82·92	Rb 85·45	Sr 87·63	Yt 89·33	Zr 90·6	Cb 93·1	Mo 96·0	—	Ru 101·7	Rh 102·9	Pd 106·7
,, 7		Ag 107·88	Cd 112·4	In 114·8	Sn 118·7	Sb 120·2	Te 127·5	I 126·92			
,, 8	Xe 130·2	Cs 132·81	Ba 137·37	La 139·0	Ce 140·25	—	—	—	—	—	—
,, 9		—	—	—	—	—	—	—			
,, 10	—	—	—	—	—	Ta 181·5	W 184·0	—	Os 190·9	Ir 193·1	Pt 195·2
,, 11		Au 197·2	Hg 200·6	Tl 204·0	Pb 207·20	Bi 208·0	—	—			
,, 12	Nt 222·4	—	Ra 226·0	—	Th 232·15	—	U 238·2	—	—	—	—
Group	O.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.		

QUALITATIVE ANALYSIS.

Dry-way Tests.



The Bunsen flame has three main parts:

The inner portion (G), in which no combustion occurs, and in which the gas mixture contains about 60 per cent. of air, may be used for cooling beads from the reducing flame, to avoid oxidation; the mantle of the flame, including D, in which combustion of the mixed gases occurs; and the luminous portion, containing F, which is present only if there is an insufficient supply of air.

The six portions of the flame used are:

A. *Base of flame.* Lowest temperature, for obtaining the flame coloration of the most volatile substance in a mixture of substances which colour the flame.

B. *Zone of fusion.* Highest temperature (about 1700° C.), for testing fusibility, volatility, etc.

C. *Lower oxidising flame.* For further oxidation of oxides dissolved in beads.

D. *Upper oxidising flame.* Best with draught holes completely open. For all oxidations unless they require a higher temperature.

E. *Lower reducing flame.* As this contains unused air, it is not so energetic as F, and serves especially for reductions on charcoal and of beads of fused salts, a small flame being used for the latter.

F. *Upper reducing flame.* Not visible when draught holes are quite open, but if made too large, soot is deposited. Contains carbon, but no free oxygen, and is therefore particularly suitable for reduction of metals to be identified as incrustations.

TEST 1.

A small amount of the substance is heated in a dry ignition tube.

The colour of the residue, and the nature of any gas evolved, is noted, and the behaviour of the residue and of the gas towards moistened litmus paper examined.

(a) *Character of Residue.*

Nitrates, carbonates, sulphates, etc., of many heavy metals, also certain metals, leave black or coloured residues of oxides on ignition.

Water vapour is formed, and condenses in the cooler portions of the test-tube: from moist substances, and in larger amounts at comparatively low temperatures from salts containing water of crystallisation, and at higher temperatures from the dehydration of hydroxides and the decomposition of certain ammonium salts. The behaviour of the condensed water towards litmus paper is examined:

Alkaline reaction indicates an ammonium salt.

Acid reaction indicates presence of a volatile acid, such as one of the halogen acids, sulphurous, sulphuric, nitric, or acetic acid.

Many *Organic compounds* carbonise on heating, giving a black residue.

Metallic chlorides (silver chloride, sodium chloride, etc.) are characterised by the comparative readiness with which they can be fused.

Substance	*Original colour*	*Colour on heating*
Lead monoxide	Yellowish brown	*Reddish brown (fuses into test-tube, forming bright yellow glass)
Mercuric oxide	Scarlet or yellow	*Black (on heating to a higher temperature gives oxygen and globules of mercury)
Bismuth oxide	Greenish yellow	*Orange to reddish brown
Red lead	Red	*Black (yields oxygen at a higher temperature)
Ferric oxide	Red	*Black
Zinc oxide	White	*Yellow
Stannic oxide	White	*Pale yellowish brown
Cadmium oxide	Brown	*Dark brown
Cuprous oxide	Reddish brown	Black
Tungstic oxide	Yellowish green	*Dark orange
Molybdic oxide	Pale yellowish green	*Orange
Titanic oxide	White	Yellow (at higher temperatures, brown)

* Indicates temporary change only.

(b) *Evolution of Gas*, or other volatile decomposition product.

Product and its detection	*Indicates*
Oxygen (rekindles glowing splint).	Certain metallic oxides which decompose on heating into the metal and oxygen (*e.g.*, mercuric oxide, silver oxide), dioxides (*e.g.*, of manganese and lead) or peroxides (*e.g.*, of barium, calcium, and sodium), chlorates, bromates, perchlorates, percarbonates, persulphates, perborates, permanganates, and some nitrates and chromates.
Hydrogen.	Alkali formates.
Chlorine (by greenish colour, bleaches litmus paper, and by smell).	Platinic, auric, and certain other chlorides.
Hydrochloric acid (forms white fumes with ammonia).	Magnesium, barium, and certain other chlorides.
Bromine (brown fumes, characteristic odour).	Bromides in presence of oxidising substances.
Iodine (violet vapours, also given after mixing with ferrous sulphate).	Iodides, in presence of oxidising substances, or iodates.
Hydrofluoric acid (test-tube etched).	Certain fluorides in presence of water.
Ammonia (by smell and alkaline reaction to litmus paper).	Ammonium salts (other than nitrate and nitrite), and, under certain conditions, cyanides and cyanates. (*Note.*—Ammonium dichromate and chromate deflagrate vigorously on heating, evolving nitrogen and ammonia, and leaving a green residue of chromic oxide. Ammonium phosphate and borate leave glassy residues.)
Nitrogen (extinguishes burning splint).	Nitrites in presence of ammonium salts and moisture.
Nitrous oxide.	Ammonium nitrate.
Oxides of nitrogen (by reddish colour).	Nitrates of the heavy metals.
Carbon dioxide (by baryta water test), sometimes mixed with carbon monoxide.	Carbonates; carbon in presence of reducible oxides, or nitrates; cyanates.
Carbon monoxide (burns with blue flame), often mixed with carbon dioxide or hydrogen.	Oxalates.
Carbon disulphide (smell).	Thiocyanates of heavy metals.
Cyanogen (smell and carmine flame).	Cyanides of certain heavy metals; cyanates; thiocyanates.
Methane (luminous flame) accompanied by odour of acetone.	Acetates in presence of alkalies.

Product and its detection	*Indicates*
Sulphur dioxide (smell and reducing action).	Acid sulphites; sulphates of certain heavy metals; some thiosulphates; sulphur; sulphides; thiocyanates, etc., in presence of oxidising substances.
Sulphuric acid fumes.	Bisulphates.
Hydrogen sulphide (smell, and blackens lead acetate paper).	Sulphides, and thiosulphates in presence of water; hydrosulphites.
Hydrogen phosphide (by odour).	Phosphites, and hypophosphites.

(c) *Volatile product forms a sublimate.*

Sublimate collected and heated with a mixture of two parts of powdered charcoal and two parts of fusion mixture.

Substance	*Nature of Sublimate*	*On reheating as above*
Ammonium salt	White	Smell of ammonia; no sublimate
Mercuric chloride	White (substance melts readily)	Metallic mirror and globules of mercury
Mercurous chloride or bromide	White (substance does not melt)	
Mercuric nitrate, oxide, or cyanide	Metallic globules	
Mercuric iodide	Yellow, red on rubbing	
Mercuric sulphide	Black, and metallic globules	
Arsenious oxide (and hence arsenic oxide)	White, crystalline, deposited at distance from flame	Metallic mirror instantly dissolved by hypochlorite solution
Arsenious sulphide	Reddish yellow	
Antimony oxide	Glittering white needles, deposited near flame	Metallic mirror, very slowly dissolved by hypochlorite solution
Stibnite (antimony sulphide)	White	
Lead chloride	White (only formed at high temperature), fuses readily	
Sulphur, polysulphide, thiosulphate	Yellow, deep red drops when hot	
Iodine, certain iodides and iodates	Black, crystalline	
Oxalic acid	White crystalline, with white fumes	

TEST 2.

Substance is heated with potassium bisulphate.

In addition to results given by Test I (*b*):

Oxygen (and red or green liquid).	Chromates.
Acid fumes (dense white fumes with ammonia).	Halides.
Chlorine peroxide (similar to chlorine, but explosive).	Chlorates.
Hydrofluoric acid (test-tube etched)	Fluorides, hydrofluosilicates.
Oxides of nitrogen.	Nitrites; nitrates (best in presence of copper).
Carbon monoxide (burns with blue flame).	Formates; oxalates; cyanides; ferrocyanides; ferricyanides.
Acetic acid (characteristic smell).	Acetates.

TEST 3.

Substance is moistened with pure, concentrated hydrochloric acid and heated on a platinum wire in the non-luminous Bunsen flame.

Flame Coloration.	*Indicates*
Lavender violet.	Potassium.
Vivid bluish white.	Lead, arsenic, antimony.
Blue (afterwards green).	Copper.
Green.	Barium.
Faint yellowish green.	Molybdenum.
Yellowish green.	Boron, manganese chloride.
Golden yellow.	Sodium.
Carmine red.	Lithium.
Brick red.	Calcium.
Crimson.	Strontium.

In the case of substances such as barium sulphate, the flame coloration is best obtained by first heating the substance in the reducing flame and then moistening with hydrochloric acid. The boron flame is best given in presence of sulphuric acid, and, in presence of silicates, after admixture with calcium fluoride and potassium bisulphate.

Care should be taken to distinguish the above flame colorations from scintillations, such as are obtained with bismuth, zinc, etc., salts.

In presence of sodium, the potassium flame is masked, but is visible as a reddish violet through a blue cobalt (or better, a didymium) glass, which cuts out the sodium flame. This precaution does not, however, prevent the masking of the potassium flame in presence of strontium, lithium, and calcium. The strontium and calcium flames are sometimes masked by the presence of barium, and that of lithium by the sodium flame.

Traces of sodium are present in most compounds, and in testing for sodium the flame coloration should persist and should not be appreciably increased in intensity by mixing about 1 per cent. of sodium chloride with the original solid.

TEST 4.

A small fragment of the substance is heated with a colourless borax bead (1—1½ mm. diam.) on a platinum wire.

Oxides of	*Oxidising flame*		*Reducing flame*	
	Hot	Cold	Hot	Cold
Copper	**Green**	**Bluish green**	**Colourless**	**Brown to red (cloudy)**
Iron	**Yellowish brown**	**Yellow or colourless**	**Bottle green**	**Bottle green**
Chromium	**Yellow or dark red**	**Yellowish green**	**Green**	**Emerald green**
Manganese	**Amethyst**	**Reddish violet**	**Colourless**	**Colourless**
Cobalt	**Blue**	**Blue**	**Blue**	**Blue**
Nickel	**Violet**	**Reddish brown**	**Grey (cloudy)**	**Grey (cloudy)**
Molybdenum	**Yellow to brown**	**Yellowish green to colourless**	**Dark brown**	**Green**
Titanium	**Colourless**	**Colourless**	**Yellow to brown**	**Violet**
Uranium	**Yellow**	**Yellowish green**	**Green**	**Bottle green**
Vanadium	**Brown to yellow**	**Greenish yellow**	**Brown**	**Bottle green**

To cool beads from the reducing flame, they are held in the cold gas-mixture just above the Bunsen tube. Reduced beads of *uranium*, etc., are best obtained by introducing a fragment of stannous chloride into the bead. In the presence of iron (*e.g.*, in rutile), *titanium* gives a brownish-red bead.

The colours of the borax beads obtained with metallic sulphides and arsenides frequently differ from those given by the other salts and the oxides, *e.g.*, manganese sulphide gives a brown bead. If sulphide or arsenide is suspected, this difficulty may be overcome by fusing with a fragment of sodium peroxide.

TEST 5.

A fragment of the substance is introduced into a bead made from microcosmic salt.

In presence of *silica* or *silicates*, undissolved particles are noticed in the bead.

This metaphosphate bead gives similar colorations to the borax bead. The results given by *molybdenum* and *titanium* are more characteristic in the case of the metaphosphate bead. In the reducing flame *tungsten* gives a blue metaphosphate bead, which becomes blood-red on the introduction of ferrous sulphate.

TEST 6.

(a) A fragment of the solid is heated in an opaque bead of fusion mixture on a platinum wire.

Effervescence.	Silica, silicate; stannic, titanic, tungstic or molybdic oxides.
Yellow.	Chromate, dichromate.

(b) If (a) gives a white bead, it is re-heated with a fragment of sodium peroxide, or of potassium nitrate on platinum foil.

Yellow.	Chromium, vanadium.
Green.	Manganese.

TEST 7.

(a) The substance is heated in a clean cavity in a charcoal block in the oxidising flame.

In addition to results of Test 1 (*a*) :

Deflagration.	Nitrate, chlorate, etc
Intumescence.	Certain salts containing water of crystallisation, *e.g.* borax.
Infusible light powder.	Alumina.
Infusible white mass, incandescent whilst hot :	
Alkaline residue.	Barium, strontium, calcium, or magnesium oxide.
Neutral residue.	Zinc oxide.
Incrustation.	See Test 8.

(b) The mass from **(a)** is heated in the oxidising flame after moistening with two drops of cobalt nitrate solution.

A light powder (such as alumina) may be retained on the charcoal by first fusing with a small amount of fusion mixture.

Deep blue, fusible mass.	Phosphates, arsenates of sodium, potassium, calcium, strontium, and barium.
Blue.	Silica, silicate, borate, tungstate.
Light blue, infusible mass.	Aluminium.
Bluish green.	Tin.
Green	Zinc.
Yellowish green, infusible mass.	Titanium.
Dull green.	Antimony.
Pink (indistinct).	Magnesium.
Brown.	Barium.

TEST 8.

(a) In case substance has been found to deflagrate, it is first heated on charcoal.

Otherwise it is mixed directly with twice the amount of fusion mixture, and heated on charcoal in the reducing flame of the blow-pipe.

The product is crushed in water in a small mortar, and the washed particles tested for malleability, and with a magnetised penknife blade for magnetic properties. Colours of incrustation when hot and cold are to be compared with Test 1 (*a*).

Brilliant white malleable bead, dark red incrustation.	Silver.
Malleable white bead (marks paper), yellow incrustation.	Lead.
Brittle white bead, bluish white incrustation.	Antimony.
Brittle white bead, yellow incrustation	Bismuth.
Malleable white bead (slight yellow incrustation).	Tin.
Malleable red bead.	Copper.
Yellow bead.	Gold.
White incrustation. No bead.	Zinc.
Black incrustation, brown at edges. Yellow on fusing with anhydrous sodium thiosulphate. No bead.	Cadmium.
Deep blue incrustation.	Molybdenum.
Volatile white incrustation, garlic odour.	Arsenic.
Grey magnetic powder.	Iron, cobalt, nickel.

The powder is separated by a magnetised blade, dissolved in dilute nitric acid in an evaporating dish, and solution evaporated just to dryness over a small flame.

Brown residue.	Iron.
Pink residue.	Cobalt.
Green residue.	Nickel.

(b) If **(a)** fails to give a bead, a fragment of potassium cyanide is added and the mass re-heated, when the tin and copper beads, for example, will be more easily obtained.

(N.B.—If found to be present by Test 2, nitrates must be destroyed by a preliminary heating, or the mixture may be explosive.)

Note.—The bead obtained may be an alloy, and the following tests may be used to confirm the test. The metallic bead is divided into two pieces, and tested on a watch-glass as follows :

I. One half is warmed with dilute nitric acid (1 : 4).

White residue.	Antimony, tin
Soluble with difficulty.	Arsenic, bismuth, mercury.
Readily soluble.	Lead, cadmium, silver, copper.

(i) Solution is decanted from residue and separate portions spotted on watch-glasses with—

Dilute hydrochloric acid.	White precipitate in presence of silver or lead, and, at suitable concentrations, with bismuth.
Dilute sulphuric acid.	White precipitate in presence of lead.
Ammonia.	Blue solution in presence of copper.
Ammonium sulphide.	Yellow precipitate in presence of arsenic; brighter yellow precipitate in presence of cadmium; black precipitate in presence of silver, lead, bismuth, or mercury.

(ii) Residue is treated with ammonium sulphide.

Brown.	Tin.
Orange.	Antimony.

II. If soluble, the remainder of bead is dissolved in hydrochloric acid (1 :1), and mercuric chloride solution added.

White or grey precipitate.	Tin.

TEST 9.

The substance is mixed with slaked lime, and heated in an ignition tube.

Evolution of ammonia (smell and alkaline reaction).	Ammonium salt.
Evolution of methane (also smell of acetone).	Acetate.

TEST 10.

A lump of copper oxide held in a platinum wire is heated in the non-luminous Bunsen flame, some of the substance placed on the copper oxide and then heated.

Blue flame (afterwards green).	Chloride, bromide, or iodide.

TEST 11.

(a) Substance is placed on a piece of silver foil or a silver coin and moistened with a drop of water.

Black or brown stain on silver.	Sulphide.

(b) Substance is mixed with starch and fusion mixture and heated in an ignition tube. The mass is broken on a piece of silver foil or a silver coin and moistened with water.

Black or brown stain on silver.	Sulphur in some form.

The presence of mercury interferes with this test.

TEST 12.

The residue obtained by igniting some of the substance on a crucible lid is powdered, a piece of magnesium ribbon added, and the mixture heated in a test-tube. The test-tube is broken in an evaporating dish, and moistened with water.

Evolution of spontaneously inflammable gas (smell of decayed fish).	**Phosphate, or phosphorus in some other form.**
Evolution of spontaneously inflammable gas (green flame).	**Borate, or boron in some other form.**

Note.—On moistening *original* substance :

Smell of ammonia.	**Nitrides, metallic amides, cyanamides.**

THE REACTIONS OF IONS.

The main points of interest in the theoretical considerations governing the use and value of the tests employed in solution analysis are : (1) the Theory of Ionic Dissociation, and its consideration in conjunction with the Law of Mass Action, and (2) the formation of Complex Salts.

According to the theory of ionic dissociation, the methods of solution analysis may be regarded as depending almost entirely on the chemistry of the *ions* and not of the *elements*. The characteristic reactions of ions containing the elements are used for the identification of the elements, and the condition in which they are present (*e.g.*, arsenic as chloride, or arsenate, etc.) In other words : *the properties of a dilute solution of a salt are, in general, the sum of the properties of its ions.*

A detailed account of the theory of ionic dissociation, the reasons for its adoption and its advantages as a working hypothesis, will be found in most text-books on theoretical chemistry, and it will here be sufficient to indicate its application for explaining the reactions used in solution analysis.

In case a reaction tends to go in either direction under certain circumstances, it is termed *balanced* or *reversible.* For example, on mixing a solution of potassium iodide in excess with cupric acetate, cupric iodide is formed, but immediately decomposes into white cuprous iodide and iodine. If this iodine is removed rapidly by addition of just sufficient sodium thiosulphate, and then a solution of starch added, the liquid will become blue on standing for a short time, showing that more iodine has been liberated. This indicates that the decomposition of the cupric iodide was incomplete, an *equilibrium* having been established between the cupric

iodide and the cuprous iodide and iodine; this is represented by the *reversible* reaction :

$$2CuI_2 \rightleftarrows Cu_2I_2 + I_2.$$

In an aqueous solution of sodium chloride, there are present in equilibrium definite concentrations of sodium *ions* and of chloride *ions*, formed by dissociation of sodium chloride, and *undissociated molecules* of sodium chloride. (The ions or the molecules may be associated with molecules of water.) This condition of equilibrium is represented by the reversible reaction :

$$NaCl \rightleftarrows \overset{+}{Na} + \overset{-}{Cl}$$

in which the metallic ion (*cation*) is a positively charged atom, and the acid radical (*anion*) is a negatively charged atom. In the case of ammonium salts, nitrates, etc., it becomes necessary to substitute the word "grouping" for "atom." Thus in the case of silver nitrate, ionisation occurs as follows :

$$AgNO_3 \rightleftarrows \overset{+}{Ag} + \overset{-}{NO_3}$$

resulting in the production of silver ions and nitrate ions. It follows that on mixing a solution containing silver ions and nitrate ions with a solution containing sodium ions and chloride ions, the mixture contains momentarily silver, nitrate, sodium, and chloride ions, but as the silver ion is not "bound" to the nitrate ion, it can just as freely enter into combination with the chloride ion, which is not "bound" to the sodium ion. The precipitation of the non-ionised silver chloride results.

The process of *neutralisation* is essentially an ionic reaction. For example, in the neutralisation of caustic soda with hydrochloric acid, these substances are ionised as follows :

$$NaOH \rightleftarrows \overset{+}{Na} + \overset{-}{OH}$$

$$HCl \rightleftarrows \overset{+}{H} + \overset{-}{Cl}$$

and the reaction may be written :

$$\overset{+}{Na} + \boxed{\overset{-}{OH} + \overset{+}{H}} + \overset{-}{Cl} = \overset{+}{Na} + \overset{-}{Cl} + H_2O.$$

The neutralisation depends on the combination of hydrogen ions (the presence of which is known as acidity) with hydroxyl ions (the presence of which is known as alkalinity) to form the practically non-ionised water. The neutralisation of sulphuric acid with caustic soda is similarly a combination of hydrogen ions with hydroxyl ions, the dissociation of the sulphuric acid being more complex on

account of the formation of further ions by a secondary dissociation.

It will be evident that the reaction which occurs in such a neutralisation is merely the formation of water, and it may be mentioned as supporting this view that the heats of neutralisation of equivalent amounts of "strong" acids (see below) with "strong" bases have been found to be the same. Most salts are highly ionised in aqueous solution, certain mercuric salts constituting notable exceptions.

The relative concentrations of the ions and of the undissociated molecules in the above reversible equations depend upon the concentration (grams per unit volume) of the dissolved substance and the temperature of the solution. The *percentage* of molecules ionised increases with the dilution, but the *number* of ions will be greater in more concentrated, though still dilute, solutions. It has been found convenient to apply the term "strong" to those acids and alkalies which become very considerably ionised at moderate dilution, *i.e.*, the mineral acids and caustic alkalies. The term "weak" has been used to indicate other acids and alkalies, such as the organic acids, ammonia, etc., which are not ionised to any great extent, even at great dilution.

The process of adding sodium acetate in order to "suppress" the action of mineral acids in solutions depends on the union of hydrogen ions of the highly ionised mineral acid with the acetate ions of the sodium acetate to form the slightly ionised acetic acid. Thus the concentration of hydrogen ions in a solution of a zinc salt containing hydrochloric acid is sufficient to prevent the ionisation of the hydrogen sulphide in solution to a sufficient extent to bring about the precipitation of zinc in Group II, but on addition of sodium acetate, that is, in a solution containing acetic acid, the number of hydrogen ions present is not sufficient to prevent precipitation of zinc sulphide by hydrogen sulphide (see Group IV separation). A further, secondary effect aids this "suppression" of hydrogen ions if an excess of sodium acetate is used. Acetic acid dissociates into hydrogen ions and acetate ions as follows:

$$CH_3COOH \rightleftarrows CH_3\overset{-}{C}OO + \overset{+}{H}$$

an equilibrium being established at a given temperature between definite concentrations of hydrogen and acetate ions and undissociated molecules of acetic acid.

The principle governing such an equilibrium is known as the Law of Mass Action. According to this principle, if *a* and *b* represent the concentration of hydrogen ions and

acetate ions respectively, and c represents the concentration of acetic acid molecules, then $(a \times b)/c = K$ (a constant which depends upon the temperature). On addition of sodium acetate, the concentration of acetate ions (b) is increased, and the concentration of hydrogen ions (a) is decreased.

Another example is the liberation of iodine from potassium iodide solution by nitrites acidified with acetic acid; on addition of much alkali acetate, the concentration of hydrogen ions is not sufficient to form free nitrous acid, even though the solution may be acid to litmus, and hence no iodine is liberated.

Similar considerations apply to the precipitation of sodium chloride by adding concentrated hydrochloric acid to a concentrated solution of sodium chloride. Due to the increase in the concentration of the chloride ion, the "solubility product" (product of concentrations of ions in a saturated solution) of the sodium and chloride ions, which is smaller than that of the hydrogen and chloride ions, is passed, and supersaturation occurs. The precipitation of the excess sodium ions and chloride ions as sodium chloride results. As the so-called "insoluble" compounds are soluble to some extent in water, it will readily be understood why an *excess* of a reagent should be added to make the precipitation more complete.

The dissolution of an "insoluble" substance in an acid or a solution of a salt may also be interpreted on the basis of the ionic hypothesis. The solubility of calcium oxalate in dilute mineral acids may be ascribed to the tendency towards the formation of the less highly ionised oxalic acid. Similarly the solubility of lead sulphate in ammonium acetate has been stated to be due to the formation of a less highly ionised basic lead acetate.

The action of ammonium chloride in preventing the precipitation of magnesium and certain other hydroxides by ammonia has a most important application in the analytical tables. It has been proved that this action is not due to the formation of a complex magnesium ammonium chloride, no such salt existing in the solution, but to the slight solubility of magnesium hydroxide in water. Whereas ferric, aluminium, etc., hydroxides are quite insoluble in water, magnesium hydroxide dissolves to some extent, and the saturated solution is almost completely dissociated according to the reversible equation:

$$Mg(OH)_2 \rightleftarrows \overset{++}{Mg} + \overset{-}{OH} + \overset{-}{OH}.$$

From the Law of Mass Action, it will be evident that

any increase in the concentration of the hydroxyl ions will result in the formation of more magnesium hydroxide, which will be precipitated as the solution is already saturated with this substance. As an addition of ammonia will increase the concentration of hydroxyl ions, it follows that magnesium hydroxide will be precipitated. The hydroxyl ions are formed by the ionisation of the ammonium hydroxide present in ammonia solution :

$$NH_4OH \rightleftarrows \overset{+}{N}H_4 + \overset{-}{O}H$$

and it follows that if ammonium chloride is added, the increase in the concentration of the ammonium ions will result in a decrease in the concentration of the hydroxyl ions. Consequently, if sufficient ammonium chloride is present to decrease the concentration of hydroxyl ions, the solubility products of the hydroxides of magnesium and the metals of Group IV are not attained, and they are not precipitated by ammonia. In the case of the metals of Group V, the concentration of hydroxyl ions in ammonia solution is never sufficient to attain the solubility products of the hydroxides of metals of this group, which are hence not precipitated by ammonia.

The alteration of the position of equilibrium in a reversible action is illustrated by the manner in which aluminium phosphate dissolves in a hot solution of sodium carbonate, but separates again on cooling. Aluminium phosphate is soluble in caustic soda, and the reversible reaction representing the hydrolysis of the sodium carbonate :

$$Na_2CO_3 + 2H_2O \rightleftarrows 2NaOH + H_2CO_3$$

proceeds to a greater extent in the direction of forming free caustic alkali at the higher temperature.

Formation of Complex Ions.

On adding a solution of potassium iodide to a solution of mercuric chloride, the precipitate of mercuric iodide is found to be soluble in an excess of potassium iodide. The addition of caustic soda to this solution does not give a precipitate, whereas the addition of caustic soda to the mercuric chloride solution would give a precipitate. The reactions of salts in solution have already been stated to be the sum of the reactions of their ions, and hence the mercuric ion must be absent from the former solution. This is considered to be due to the presence in the solution of a *complex ion*, $[HgI_4]$, which contains the mercury in a form in which it does not give the reactions of the mercuric ion, thus :

$$HgI_2 + 2KI = K_2[HgI_4].$$

On ionisation, this compound will give $K^{\cdot}$ and $[HgI_4]''$ ions, but no $Hg^{\cdot\cdot}$ ions.

Similar considerations apply to many other halides, and to the cyanides. For example, a method frequently used for detecting cadmium in presence of copper (Group II separation) is to add potassium cyanide to the blue, ammoniacal solution until it has become decolorised, and then to pass in hydrogen sulphide to precipitate any cadmium present. [A disadvantage of this method is that, in presence of much copper, a red or orange precipitate of dithio-oxamide is obtained, and this may be mistaken for cadmium sulphide.] This method depends upon the solution of cupric cyanide in an excess of potassium cyanide to form a compound in which the copper is present in a colourless complex ion, from which it is not precipitated by hydrogen sulphide; hence the disappearance of the characteristic blue colour of the cupric ion on addition of potassium cyanide.

In ammoniacal solution, copper is present in an intense blue complex ion $[Cu(NH_3)_4]$, to the production of which, by the solution of the basic salt first precipitated, the ammonia test for copper is due.

The so-called "platinic chloride," used in testing for potassium, is actually chlorplatinic acid $H_2[PtCl_6]$, in which the platinum forms part of a complex anion. The addition of the true platinic chloride ($PtCl_4$) to a solution of potassium chloride gives a precipitate only after standing for a considerable time, on account of the extremely slow formation of the potassium chlorplatinate, $K_2[PtCl_6]$, under these conditions. Similarly "auric chloride" is actually the compound chlorauric acid, $H[AuCl_4]$, and the colourless solution of cuprous chloride in hydrochloric acid contains a complex compound, probably $H_2[CuCl_3]$.

The *double salts* should be differentiated carefully from the *complex salts*. Whereas the latter contain complex ions in solution, solutions of double salts, such as the alums, give the same ionic reactions as the single salts. In this connection it is to be noted, however, that certain complex salts undergo a secondary dissociation, *e.g.*, solutions of ferri-oxalates contain ferric and oxalate ions in addition to $[Fe(C_2O_4)_3]$ ions.

The fact that certain complex ferrous salts also undergo a secondary dissociation may be used in testing for ferrous salts; in presence of ammonium citrate and ammonia, ferrous ions may be detected by adding an alcoholic solution of dimethylglyoxime, when a pink coloration is produced.

SOLUTION ANALYSIS.

SOLUTION OF A SOLID SUBSTANCE.

The behaviour of the substance on warming with the following solvents should be examined :

(1) *Water.*

Evolution of	*Indicates*
Oxygen.	**Peroxides of the alkali or alkaline earth metals.**
Methane.	**Aluminium and other carbides.**
Acetylene.	**Calcium and other carbides.**
Hydrochloric acid.	**Chlorides of certain non-metals.**
Carbon dioxide.	**Bicarbonate, or carbonate in presence of an acid or an acid salt.**
Hydrogen phosphide	**Phosphides of the alkali or alkaline earth metals.**
Hydrogen sulphide.	**Sulphides of magnesium, aluminium, etc.**

(2) *Dilute hydrochloric acid.*

Evolution of	*Indicates*
Hydrogen.	**Presence of a metal.**
Oxygen.	**Peroxide.**
Chlorine.	**Presence of an oxidising agent.**
Oxides of nitrogen.	**Nitrite.**
Carbon dioxide.	**Carbonate, percarbonate, cyanate.**
Methane, acetylene, etc.	**Carbide.**
Acetic acid.	**Acetate.**
Sulphur dioxide.	**Sulphite.**
Sulphur dioxide and liberation of sulphur.	**Thiosulphate.**
Hydrogen sulphide.	**Sulphide, hydrosulphite.**
Hydrogen sulphide and liberation of sulphur.	**Polysulphide.**
Hydrogen cyanide.	**Cyanide, ferrocyanide, ferricyanide.**

(3) *Concentrated hydrochloric acid.* As certain metallic chlorides are volatile with hydrochloric acid, such a solution may be warmed, but should not be boiled.

(4). *Dilute nitric acid.* In addition to the behaviour observed in (2) :

Evolution of nitrous fumes.	**Presence of metal.**

(5) *Concentrated nitric acid.* Mercurous chloride dissolves as mercuric nitrate, and hence the state of the mercury must be ascertained by testing in the original solid (*e.g.*, blackening by ammonia indicates mercurous chloride).

Solutions in nitric acid should be evaporated almost to dryness before proceeding with the analysis. It is to be remembered that sulphides, etc., have probably been oxidised by the treatment with nitric acid.

(6) *Concentrated sulphuric acid* decomposes complex cyanides.

(7) *Aqua regia.* (One vol. of concentrated nitric acid to four vols. of concentrated hydrochloric acid). This should only be used if all the above solvents have failed.

All solutions in strong acids must be diluted with five or six times their volume of water before proceeding to the group tests.

White precipitate on dilution, soluble in hydrochloric acid.	**Antimony or bismuth (the former only is soluble in tartaric acid).**

In case it is not found possible to dissolve the whole of the substance, a portion may have been dissolved by one of the above solvents (as found by carefully evaporating some of the filtrate to dryness at the lowest possible temperature). The solution obtained is used for the group tests, and the residue examined by the special tests for insoluble substances.

EXAMINATION OF A SOLUTION.

General tests.

(*a*) Unless the solution has been made by dissolving a substance in an acid as above, its smell should be noted, and it should be tested with litmus paper.

Alkaline solution.	**Presence of an alkali, basic salt, hydrolysed salt of a strong base with a weak acid (normal alkali carbonate, alkali borate, cyanide, sulphide, silicate, hypochlorite, commercial alkali nitrate, trimetallic phosphate, stannate, antimonate, zincate, molybdate, or tungstate).**
Acid solution.	**Presence of an acid, acid salt (bisulphate, bicarbonate, acid phosphate, dichromate) or hydrolysed salt of a strong acid with a weak base (cupric, ferric, etc. salts).**

(*b*) It is useful, though not conclusive, to note the colour of the solution; the following is a list of the commoner colour ions:

	Cations		*Anions*
Lilac	Titanous	Purple	Permanganate
Blue	Cupric, tungstous, molybdenous	Green	Manganate, ferricyanide
Green	Cupric, cuprous, nickel, ferrous, chromic	Orange	Dichromate
Yellow	Ferric, uranium	Yellow	Chromate, ferrocyanide
Pink	Cobalt, manganese		

In addition, bromine solution is orange, and a solution of iodine in an iodide is brown.

(*c*) A small portion is evaporated to dryness and examined by dry-way tests. In case no residue is obtained, and solution is acid, it is neutralised with sodium carbonate and tested for acids.

(*d*) *Special tests for Hydrogen peroxide.*

(1) In case solution is slightly alkaline, cobalt nitrate solution is added. Black precipitate in absence of hypochlorite and sulphide (which could not co-exist with hydrogen peroxide, as they would be reduced to chloride and oxidised to sulphate respectively) indicates hydrogen peroxide.

(2) Solutions of gold are reduced to the metal, with liberation of oxygen, at the ordinary temperature by alkaline hydrogen peroxide.

(3) In the case of an acid solution, titanium sulphate is added. A yellow coloration due to the formation of pertitanic acid indicates the presence of hydrogen peroxide, in absence of chlorate.

(4) The dichromate test is also available for the detection of hydrogen peroxide in acid solution, provided that a "blank" is carried out. The solution is acidified with sulphuric acid and potassium dichromate solution added. The liquid is shaken with ether, when a blue ethereal layer, due to perchromic acid, indicates the presence of hydrogen peroxide.

Tests for Ozone. Ozone does not (1) give a yellow coloration with titanium sulphate, or (2) precipitate gold from solutions of its salts, but (1) liberates iodine *immediately* from dilute *neutral* potassium iodide solution, (2) liberates bromine immediately from an acidulated solution of sodium bromide, and (3) immediately turns silver foil heated to 250° steel blue (this reaction does not occur in the cold unless the silver foil has been treated with nitric acid, or has been cleaned

with emery paper, the iron oxide in which appears to act as a catalyst). These latter reactions are not given by hydrogen peroxide.

(*e*) *Detection of free Alkali.*

After destroying hydrogen peroxide by boiling, the presence of free alkali, possibly formed by the hydrolysis of an alkali peroxide, in an alkaline solution may be detected in presence of an alkali carbonate by adding an excess of barium chloride and filtering to remove the barium carbonate precipitated. Alkaline filtrate indicates presence of free alkali.

I. Acid Radicals (Anions).

TEST 1.

The substance is warmed with dilute sulphuric acid :

Evolution of	*Indicates*
Hydrogen.	A metal.
Oxygen.	Peroxide.
Chlorine.	Hypochlorite, or chloride in presence of an oxidising agent.
Oxides of nitrogen.	Nitrite.
Carbon dioxide.	Carbonate, percarbonate, cyanate.
Methane, acetylene, etc.	Carbide.
Acetic acid.	Acetate.
Sulphur dioxide.	Sulphite.
Sulphur dioxide and liberation of sulphur.	Thiosulphate, thiocyanate.
Hydrogen sulphide.	Sulphide.
Hydrogen sulphide and liberation of sulphur.	Polysulphide, hydrosulphite.
Hydrogen cyanide.	Cyanide, ferrocyanide, ferricyanide.

TEST 2.

The substance is heated with concentrated hydrochloric acid :

Evolution of	*Indicates*
Chlorine.	Presence of an oxidising agent, *e.g.*, dioxide, chlorate, nitrate, persulphate, chromate, dichromate, permanganate.
Carbon dioxide and hydrogen sulphide.	Thiocyanate.

TEST 3.

A small amount of the substance is warmed very cautiously with a few drops of concentrated sulphuric acid. In addition to results in Test 1 :

Evolution of	*Indicates*
Oxygen (frequently mixed with ozone).	Dioxide, permanganate, dichromate, chromate, persulphate.
Hydrochloric acid.	Chloride.
Chlorine.	Chloride in presence of an oxidising agent.
Chlorine dioxide (explosive).	Chlorate.
Chromyl chloride (colours non-luminous Bunsen flame white).	Chloride in presence of a chromate.
Bromine.	Bromide or bromate.
Iodine.	Iodide or iodate.
Silicon fluoride.	Fluoride, hydrofluosilicates.
Oxides of nitrogen.	Nitrate.
Sulphur dioxide.	Metal, sulphide, carbon in some form.
Sulphur dioxide and liberation of sulphur.	Thiosulphate, thiocyanate.
Sulphur dioxide and hydrogen sulphide, in addition to iodine.	Iodide.
Carbon monoxide.	Cyanide, ferrocyanide.
Carbon dioxide and monoxide (without blackening).	Ferricyanide, oxalate.
Carbon dioxide and monoxide, and sulphur dioxide (with blackening).	Tartrate.

TEST 4.

The substance is heated with manganese dioxide and dilute sulphuric acid. In addition to results in Test 3 :

Chlorine.	Chloride.
Bromine.	Bromide.
Iodine.	Iodide.

TEST 5.

Substance or solution is boiled with an excess of sodium carbonate* solution for five minutes, and filtered if necessary. The clear filtrate is divided into three portions, and treated as follows :

(1) One portion is neutralised by adding dilute nitric acid†

* Chloride and sulphate are frequently present in traces in sodium carbonate, and hence a "blank" should be carried out, unless the precipitates obtained (with silver nitrate and barium chloride respectively) are very definite.

† On acidifying with nitric acid, any sulphite, sulphide, etc., in the solution may be decomposed. A precipitate may be obtained in presence of certain sulphur acids, silicates, tungstates, molybdates, zincates, stannites, stannates, etc. The ppt. is examined by the dry-way tests, and the filtrate tested for acid radicals.

slowly until no more effervescence occurs on further addition, then ammonium carbonate added again until no further effervescence occurs, and the liquid boiled for several minutes to destroy the excess. The neutral solution is treated with :

Silver nitrate solution. After filtering, the behaviour of portions of the precipitate towards hot water, dilute nitric acid, and ammonia is examined. In case the nitric acid appears to dissolve any of the precipitate, the liquid is filtered, and ammonia added carefully to the filtrate to reprecipitate the silver salt, which may probably be identified by the colour of the ring produced.

White precipitate :	
Soluble in hot water.	Sulphate, nitrite, acetate, benzoate, salicylate.
Decomposed by acetic acid.	Silicate
Insoluble in dilute nitric acid :	
Soluble on heating. Solution in ammonia (1 : 20) gives yellow precipitate on addition of sulphur dioxide.	Bromate, iodate.
Curdy precipitate, soluble in ammonia.	Chloride, hypochlorite, cyanide, thiocyanate.
Insoluble in ammonia, soluble in potassium cyanide, becomes orange and soluble in ammonia on boiling with concentrated nitric acid.	Ferrocyanide.
Soluble with difficulty in nitric acid.	Selenite.
Soluble in nitric acid and in ammonia :	
Curdy precipitate.	Cyanate, pyrophosphate, molybdate, oxalate.
Curdy precipitate, solution in ammonia deposits silver on warming.	Tartrate.
Amorphous precipitate.	Metaphosphate.
Amorphous precipitate, becomes brown on warming.	Borate.
Crystalline precipitate, becomes black on warming.	Sulphite, thiosulphate, formate, citrate.
Pale yellow precipitate :	
Insoluble in dilute nitric acid and in very dilute ammonia (1 : 20).	Bromide.
Yellow precipitate :	
Insoluble in dilute nitric acid and in ammonia.	Iodide.
Soluble in nitric acid and in ammonia :	
Insoluble in acetic acid.	Phosphate.
Soluble with difficulty in acetic acid; solution in ammonia deposits silver on warming.	Arsenite.
Curdy, brownish precipitate.	Vanadate.

Orange precipitate :	
Insoluble in dilute nitric acid, soluble in ammonia and in potassium cyanide.	Ferricyanide
Chocolate brown precipitate :	
Soluble in nitric acid and in ammonia, insoluble in acetic acid.	Arsenate.
Reddish brown precipitate :	
Soluble in nitric acid and in ammonia, insoluble in acetic acid.	Chromate.
Black precipitate :	
Insoluble in cold, dilute nitric acid, dissolves on warming.	Sulphide, hydrosulphite.
Soluble in cold, dilute nitric acid.	Phosphite, hypophosphite.

(2) Another portion is neutralised as in (1), using hydrochloric acid in place of nitric acid, and the neutral solution divided into three portions. To these are added :

(a) *Calcium chloride solution.*

White crystalline precipitate, soluble in concentrated hydrochloric acid	Sulphate or sulphite (in considerable amount).
White precipitate, soluble in acids.	Phosphite.
White precipitate, decomposed by acetic acid.	Silicate.
White precipitate, soluble in excess of pyrophosphate.	Pyrophosphate.
White amorphous precipitate, soluble in acetic acid and in ammonium chloride.	Borate.
White amorphous precipitate, (gelatinous in presence of ammonia), soluble in acetic acid.	Phosphate, arsenate, arsenite.
White amorphous precipitate, soluble in hydrochloric acid (reprecipitated by ammonia), insoluble in acetic acid.	Oxalate.
White gelatinous precipitate, soluble in acetic acid (until the precipitate has become crystalline). Soluble in caustic potash, precipitated on warming, redissolves on cooling.	Tartrate.
White gelatinous precipitate, soluble with difficulty in dilute hydrochloric acid, insoluble in acetic acid, soluble in ammonium chloride.	Fluoride.
White precipitate, less soluble in hot water than in cold, insoluble in caustic potash, soluble in ammonium chloride.	Citrate.
White precipitate on warming.	Ferrocyanide.
White precipitate on addition of alcohol.	Malate

(b) *Barium chloride solution.*

White precipitate, soluble in hydrochloric acid. (If sulphite is present, addition of bromine water to solution of precipitate in hydrochloric acid gives precipitate of barium sulphate.)	Sulphite, selenite, phosphate, arsenate, arsenite, borate, bromate, iodate, periodate, pyrophosphate, molybdate, vanadate, oxalate, tartrate.
White precipitate, soluble in excess of metaphosphate and in hydrochloric acid.	Metaphosphate.
White precipitate decomposed by acetic acid.	Silicate.
White precipitate, soluble in acetic acid.	Phosphite.
White, crystalline precipitate almost insoluble in dilute hydrochloric acid.	Hydrofluosilicate.
White, voluminous precipitate, soluble with difficulty in hydrochloric acid.	Fluoride.
White precipitate, insoluble in concentrated hydrochloric acid.	Sulphate.
White precipitate, insoluble in nitric acid, soluble in hydrochloric acid.	Selenate.
White precipitate on boiling.	Persulphate, ferrocyanide.
White precipitate in concentrated solution.	Thiosulphate.
Yellow precipitate, soluble in dilute hydrochloric and nitric acids, insoluble in acetic acid.	Chromate, dichromate.

(c) *Ferric chloride solution.*

Blue precipitate.	Ferrocyanide.
Red solution, brown precipitate on boiling.	Acetate.
Pink precipitate, soluble in hydrochloric acid, white crystals on cooling.	Benzoate.
Light yellow precipitate.	Succinate.
Pale yellow precipitate, insoluble in acetic acid.	Phosphate.
Dark brown solution.	Ferricyanide.
Blood-red coloration, extracted by ether, destroyed by mercuric chloride but not by hydrochloric acid.	Thiocyanate.
Transitory claret coloration, destroyed by acids.	Thiosulphate.
Deep violet coloration.	Salicylate.

(3) A further portion of filtrate is acidified with dilute sulphuric acid, an equal volume of ferrous sulphate solution added, and concentrated sulphuric acid carefully poured into the test-tube to form a layer :

Brown ring.	Nitrate, nitrite.
Violet ring.	Iodide.
Red coloration (at bottom of sulphuric acid layer).	Bromide.

CONFIRMATORY TESTS FOR CERTAIN ACID RADICALS.

Chlorides, Bromides and Hypochlorites.

On distilling a chloride with sulphuric acid and a chromate, chromyl chloride volatilises, and on collecting in water, is hydrolysed to chromate, which may be detected after neutralising. Bromides give free bromine, which may be identified after conversion into bromide by means of ammonia.

In presence of free chlorine, hydrochloric acid may be detected by shaking with mercury to free from chlorine, and testing for acidity and chloride in the filtrate. If hypochlorous acid is present, the precipitate obtained with the mercury will be brown.

Manganese sulphate gives a black precipitate in alkaline solution with hypochlorites. (Chlorates do not exert their oxidising power in alkaline solution.)

Chlorates.

(1) Dilute sulphuric acid liberates chloric acid, which gradually decomposes into perchloric acid and chlorine, and hence colours starch-iodide paper blue after standing a short time.

(2) On addition to a solution of titanous chloride, an orange solution is produced.

(3) Indigo (carmine) solution is bleached in the cold by *chlorate* in presence of sulphur dioxide, the presence of which is not necessary in the case of a warm solution of a *nitrate* acidified with sulphuric acid.

Perchlorates.

(1) On reduction with titanous sulphate, or by digesting in alkaline solution with ferrous hydroxide, chlorides are produced.

Chlorides are also produced on ignition, alone or in presence of an alkali nitrite.

(2) Concentrated solutions give a white, crystalline precipitate on addition of a concentrated solution of potassium chloride.

Bromates.

Sulphurous acid, hydrogen sulphide, zinc and an acid, etc., give bromide.

Iodates.

(1) Hydriodic acid, or acidified potassium iodide, reduces iodic acid with liberation of iodine.

(2) Sulphurous acid causes the liberation of iodine.

(3) Pyrogallol solution gives a brown solution (not given by chlorates or bromates).

Nitrates.

(1) Iodine is not liberated from dilute solutions of potassium iodide acidified with acetic acid until a fragment of zinc is added to reduce to nitrite.

(2) The solution under examination is mixed with three times its volume of pure, concentrated sulphuric acid, and 1 cc. of a brucine solution (0·2 grm. in 100 cc. of pure, concentrated sulphuric acid) added. Nitrates give a red coloration which rapidly changes through orange and golden yellow to yellowish green. (*Note.*—As nitrites decompose and give small amounts of nitrates on addition of sulphuric acid, they also give the brucine test.)

(3) A dilute acetic acid solution of "nitron," diphenylendanilo-dihydrotriazole, gives a white, crystalline precipitate with very dilute solutions (also given by tungstates).

(4) In absence of nitrites, nitrates may be identified, after reduction to ammonia, by Nessler solution.

(5) Indigo (carmine) solution is decolorised by free nitric acid.

Detection of Nitrate in Sulphuric Acid.

Although the diphenylamine test is given by many oxidising substances other than nitrates (nitrites, chlorates, etc.), it is available for the detection of traces of nitrogen acids in concentrated sulphuric acid in absence of ferric salts and of selenic acid. The reagent is prepared by dissolving 0·5 grm. of diphenylamine in 100 cc. of pure, concentrated sulphuric acid, and adding carefully 20 cc. of water. This solution is carefully poured on to the acid under examination. On standing for several minutes, the presence of nitrogen acids is shown by the production of a blue ring.

Nitrites.

(1) Solutions acidified with sulphuric acid decolorise potassium permanganate.

(2) On addition of acidified potassium iodide, iodine is liberated, soluble in carbon disulphide to a violet solution. Detection of the iodine with starch renders this the most delicate test for nitrite in absence of other oxidising agents.

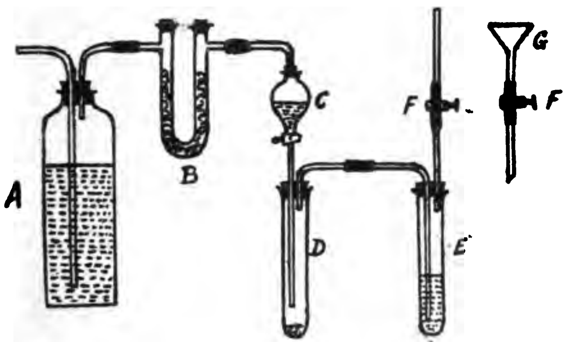
(3) The production of intensely coloured azo-compounds constitutes an extremely delicate test for nitrites in water, etc., in which case the potassium permanganate test fails, as traces of hydrogen peroxide and of ferric salts may be present.

The original reagent, suggested by Griess, was *meta*-phenylenediamine, which gives a yellow coloration or brown precipitate in presence of hydrochloric acid.

A more delicate test is to add 2 cc. of an acetic acid solution of sulphanilic acid and α-naphthylamine, when within five or ten minutes a mere trace of nitrite will produce a red solution. The reagent is prepared as follows: 0·5 grm. sulphanilic acid are dissolved in 150 cc. of dilute acetic acid; 0·2 grm. of α-naphthylamine are extracted with 20 cc. of water, the colourless solution decanted, and mixed with 150 cc. of dilute acetic acid. The two solutions are mixed, and preserved in the dark.

Carbonates.

A suitable apparatus for the detection of traces of carbonate is shown in the sketch. D is a boiling tube, containing the



substance under examination, and fitted with a two-holed rubber stopper. Through one hole passes the stem of a small tap-funnel, C, the stopper of which is removed, and the top connected to a soda-lime tube, B, and this to a wash-bottle, A, containing caustic potash solution. D is connected to another boiling tube, E, as shown, which in turn is connected to a small piece of rubber tubing and screw-clamp, F. F serves to connect the boiling tube E either to the pump, or to the funnel, G. At first, both C and E are empty. The screw-clamp, F, is opened, and a slow current of air, freed from carbon dioxide, drawn through the apparatus for five minutes. The screw-clamp is closed, and the funnel G, fitted with a filter paper, inserted, and a suitable volume of baryta water poured on to the filter-paper. The tap-funnel is closed, and the soda-lime tube and wash-bottle disconnected. F is opened, and

the tap-funnel adjusted so that the baryta-water filters into the tube E. The tap-funnel and F are closed, the funnel G removed, and the apparatus again connected to the vacuum pump. About 10 cc. of dilute hydrochloric acid are introduced into the tap-funnel, which is then connected to the soda-lime tube and wash-bottle again, F is opened, and the tap-funnel adjusted so that the acid is drawn into D. A slow current of air is drawn through the apparatus for five minutes. The screw-clamp is closed, and any barium carbonate formed is easily detected by placing a piece of black paper under the boiling tube.

Percarbonates.

(1) On standing in solution, hydrogen peroxide and a bicarbonate are produced, and may be detected by the usual methods.

(2) Addition of the solid to a 25 per cent. solution of potassium iodide liberates iodine.

Cyanides.

(1) After evaporation of a cyanide with a few drops of yellow ammonium sulphide, free from thiosulphate (see Reagents), on a watch-glass, and acidifying with hydrochloric acid, ferric chloride gives a blood-red coloration.

(2) Addition of a small amount of ferrous sulphate to an alkaline solution converts cyanide into ferrocyanide, which may be detected by ferric chloride after acidifying with hydrochloric acid.

Ferrocyanides.

Insoluble ferrocyanides, such as Prussian blue, are identified after digesting with caustic soda.

Ferricyanides.

(1) Ferricyanides give a blue precipitate on addition of an acid solution of ferrous sulphate.

(2) Cadmium chloride gives a white precipitate insoluble in acids (not given by thiocyanates).

Cyanates.

(1) Dilute sulphuric acid gives carbon dioxide and ammonia, together with undecomposed cyanic acid, which has a pungent odour. The ammonium sulphate produced may be detected by warming with caustic soda solution.

(2) Cyanates may be detected in commercial cyanides by passing carbon dioxide into the solution to free from hydrocyanic acid, and then adding 25 cc. of alcohol to 1 cc. of the liquid to precipitate the carbonate. Addition of an alcoholic solution of cobalt acetate to the filtrate acidified with several drops of acetic acid gives a blue coloration (also given by thiocyanates).

Thiocyanates (Sulphocyanides).

(1) Mercuric nitrate gives white precipitate, soluble in excess of thiocyanate.

(2) Zinc and sulphuric acid give hydrogen sulphide.

See also cyanates (2).

Sulphates.

Benzidine hydrochloride gives a white precipitate of the sulphate (also given by tungstates).

Sulphites.

(1) Acidified potassium permanganate solution and iodine solution are decolorised; chromates are reduced to green chromium salts.

(2) Sodium nitroprusside gives a pink coloration which becomes red on addition of zinc sulphate. The reaction is made more delicate by adding a few drops of potassium ferrocyanide, when a red precipitate is obtained (not given by thiosulphates).

(3) Zinc and dilute sulphuric acid give a yellow coloration due to the production of hydrosulphurous acid. The same result is obtained on addition of a solution of a titanous salt.

(4) Stannous chloride gradually gives a yellow precipitate.

Sulphides.

(1) Lead nitrate, to which an excess of caustic soda has been added to give a clear solution, gives a black precipitate.

(2) Alkaline solutions give a reddish-violet coloration with a dilute solution of sodium nitroprusside.

(3) The most delicate reaction for hydrogen sulphide in water from mineral springs, etc., is the formation of methylene blue. To the liquid under examination is added one-tenth of its volume of concentrated hydrochloric acid and a small amount of dimethyl-*para*-phenylenediamine sulphate, the solution stirred, and then one or two drops of ferric chloride solution added. In the presence of amounts much less than those which can be detected by tests (1) or (2), a blue colour is produced after standing for half an hour.

Thiosulphates.

(1) Iodine solution is decolorised.

(2) On heating with zinc and hydrochloric acid, hydrogen sulphide is produced (also given by sulphites).

(3) Silver chloride and iodide, mercurous chloride, lead sulphate, etc., are dissolved by solutions of alkali thiosulphates.

Persulphates.

(1) Dilute solutions decompose, a large amount of ozone being formed, which may be detected by means of starch-iodide paper.

(2) In presence of an alkali, a black precipitate is obtained on addition of manganese, cobalt, etc., salts. (Persulphates are distinguished from hydrogen peroxide in that they do not decolorise permanganate solutions nor colour titanium sulphate solution yellow, nor give a blue colour with chromic acid and ether, except on standing or on heating in solution, when hydrogen peroxide is produced.)

(3) Barium chloride does not give a precipitate with fresh solutions, but on standing, more rapidly on boiling, sulphate is formed and a precipitate is obtained.

Hydrosulphites.

(1) Hydrosulphurous acid, produced by the addition of a dilute acid, forms a yellow solution.

(2) Ammoniacal cupric sulphate gives a yellowish-red precipitate of cuprous hydride.

(3) Alkaline solutions decolorise acidulated indigo carmine; the solution obtained becomes blue on exposure to air on filter-paper.

Selenates.

Hydrogen sulphide gives with warm solutions SeO_2, which then gives a yellow precipitate, soluble in ammonium sulphide.

Selenites.

(1) Sulphurous acid gives a red precipitate.

(2) Copper sulphate gives a greenish-blue precipitate.

(3) Hydrogen sulphide gives a lemon-yellow precipitate, soluble in ammonium sulphide.

Orthophosphates.

(1) Magnesia mixture gives a white crystalline precipitate with ammoniacal solutions. The precipitation of Group III metals in this test may be prevented by the addition of ammonium citrate to the solution.

(2) Ammonium molybdate (see Reagents) gives a yellow precipitate with acid solutions.

(3) Lead acetate gives a white precipitate practically insoluble in acetic acid.

(4) Uranyl acetate gives a yellow precipitate, insoluble in acetic acid.

Metaphosphates.

(1) Magnesia mixture does not give a precipitate with dilute solutions in presence of sufficient ammonium chloride and ammonia, in the cold or on boiling.

(2) Ammonium molybdate gives a precipitate only after boiling the solution with acids to convert into orthophosphoric acid.

(3) The free acid coagulates albumen, and hence the alkali salts behave similarly on addition of acetic acid.

Pyrophosphates.

(1) Magnesia mixture gives a white precipitate, soluble in excess of magnesium salt or of the pyrophosphate, but which is permanently precipitated by boiling.

(2) Ammonium molybdate behaves as with metaphosphates.

(3) Pyrophosphoric acid does not coagulate albumen.

Phosphites.

(1) Mercuric chloride is reduced to mercurous chloride, and to mercury by excess.

(2) On evaporation, solution gives phosphoretted hydrogen.

(3) Zinc and an acid give phosphoretted hydrogen.

Hypophosphites.

Silver, copper, gold and mercury salts are reduced to metal.

Borates.

(1) The substance is mixed with calcium fluoride and concentrated sulphuric acid, and a platinum wire moistened in the mixture is held in the lower part of a bunsen flame, which is coloured green in presence of boron.

(2) On immersing turmeric paper in a solution containing free boric acid, no change occurs until the paper is carefully dried, when it becomes reddish-brown, and this colour is not changed by dilute hydrochloric or sulphuric acid (difference from the colour produced by alkalies), but is turned bluish-black by caustic alkalies.

Note.—This test is also given by hydrochloric acid solutions of molybdic and titanic acids.

(3) Concentrated solutions give a precipitate of boric acid with hydrochloric acid.

Silicates.

(1) On evaporating to dryness with hydrochloric acid, a residue of silicic acid is obtained, which becomes blue on heating with cobalt nitrate on charcoal.

(2) The addition of an ammonium salt precipitates gelatinous silicic acid.

Hydrofluosilicates (Silicofluorides).

(1) Potassium chloride gives a gelatinous precipitate of potassium hydrofluosilicate in presence of an equal volume of alcohol.

(2) Ammonia gives a precipitate of silicic acid.

(3) On heating with concentrated sulphuric acid in a *platinum* vessel, silicon fluoride is produced (not given by fluorides), and may be detected by the formation of a white precipitate on the end of a moist glass rod held in the vapour.

Arsenites.

(1) In presence of sodium bicarbonate, iodine solution is decolorised.

(2) On warming with copper foil and hydrochloric acid, a deposit of copper arsenide is obtained (not given by arsenates).

(3) In presence of concentrated hydrochloric acid, stannous chloride gives a black precipitate on warming. (Also given on addition of titanous chloride.)

(4) Copper sulphate gives a green precipitate on addition of ammonia, soluble in excess. This precipitate of cupric hydrogen arsenite forms (red) cuprous oxide on heating with caustic soda solution.

Arsenates.

(1) In presence of ammonia and ammonium chloride, magnesium chloride gives a white, crystalline precipitate (not given by arsenites).

(2) In presence of a large excess of ammonium molybdate, a yellow, crystalline precipitate is obtained on boiling (also given by arsenites, due to their oxidation to arsenate by the nitric acid in the ammonium molybdate reagent).

(3) Hydrogen sulphide first gives a white precipitate of sulphur in presence of hydrochloric acid and then a bright yellow precipitate of arsenic sulphide.

Antimonates.

On addition of potassium iodide to an acid solution, iodine is liberated. This test is not given by the alkali metantimonites, which contain Sb^{iii} in place of Sb_{v}. In alkaline solution, antimonates give with silver nitrate a black precipitate of silver oxide, soluble in ammonia, whereas the metantimonites give a precipitate which is not completely soluble in ammonia as it also contains metallic silver.

Chromates.

(1) After boiling with hydrochloric acid and alcohol, ammonia gives a bluish-green precipitate.

(2) The test for hydrogen peroxide, involving the production of perchromic acid, may also be used in identifying chromates after addition of sulphuric acid. Traces of chromate can only be detected by using ether free from alcohol.

Formates.

Mercuric chloride gives a precipitate of mercurous chloride.

Acetates.

(1) On warming the solid with a mixture of one part of alcohol and two parts of concentrated sulphuric acid, the smell of ethyl acetate is produced.

(2) On heating with arsenious oxide give cacodyl oxide (*extremely poisonous*)

Oxalates.

(1) Calcium chloride gives a white precipitate, soluble in dilute hydrochloric and nitric acids (reprecipitated by ammonia), but insoluble in acetic acid.

(2) On warming in presence of sulphuric acid, dilute potassium permanganate is decolorised.

(3) On heating with manganese dioxide and sulphuric acid, carbon dioxide is produced.

Tartrates.

(1) Calcium chloride gives a white precipitate, which only forms slowly in dilute solutions (especially in presence of ammonium chloride). The precipitate is soluble in acetic acid, and after washing is dissolved by cold caustic alkalies, being reprecipitated on heating, and redissolved on cooling.

(2) Silver nitrate gives a white precipitate. The supernatant liquid is decanted, water added, and precipitate dissolved in *just sufficient* very dilute ammonia. On placing the solution in a water-bath at 60–70° C., a silver mirror is formed.

Note.—In presence of other acids (except borate), tartrates may be precipitated by adding solid potassium carbonate to a concentrated solution until alkaline, and carefully acidifying with glacial acetic acid. The precipitated acid potassium tartrate is washed, dissolved in dilute caustic soda, neutralised, and the test carried out as in (2) above.

(3) A neutral or acid solution, to which has been added a small amount of ferrous sulphate, gives, on addition of a few drops of hydrogen peroxide, and then an excess of caustic

soda, a deep violet or blue coloration, intensified by addition of two or three drops of ferric chloride.

(4) On warming with a 1 per cent. solution of resorcinol in concentrated sulphuric acid, a red coloration is produced.

Tartrates, Malates and Citrates.

In presence of these hydroxy-acids, ferric chloride does not give a precipitate on addition of alkali.

SPECIAL SEPARATIONS OF ACID RADICALS.

Chloride, Bromide, Iodide and Cyanide.

If a preliminary test with chlorine water has shown that a halide other than chloride is present, it is necessary to proceed as follows:

If present, *cyanide* is precipitated by adding a slight excess of nickel sulphate to neutral solution (*ferricyanides* are precipitated afterwards by adding ferrous sulphate); it is then boiled with a small amount of halogen-free caustic soda, and filtered. The filtrate is acidified with dilute sulphuric acid, and divided into two portions.

One portion of the acidified solution and a layer of chloroform are poured into a test-tube, and chlorine water added gradually, shaking after each addition. Violet solution indicates *iodide*. (Traces of iodide in presence of bromide are best detected by adding nitrite to a solution containing sulphuric acid, when only iodine is liberated.) Further addition of chlorine water decolorises the chloroform solution, which, however, becomes orange in presence of *bromide*.

On gradual addition of silver nitrate to the other half of the acidified filtrate, bromide and iodide are first precipitated, and by filtration after each addition of silver nitrate the presence of *chloride* is shown by the final precipitate being white.

Halides and Thiocyanate.

These are first precipitated with an excess of silver nitrate, and the precipitate digested on a water-bath with concentrated nitric acid for an hour, when only the silver halides remain undissolved.

Chloride, Chlorate and Perchlorate.

The *chloride* is precipitated in one portion of solution by adding an excess of silver nitrate; after filtering, the filtrate is acidified with sulphuric acid, a small piece of zinc added, and warmed. White precipitate indicates *chlorate*. The remainder of solution is reduced with sulphur dioxide, the excess boiled off, and all chloride present precipitated as silver chloride. The filtrate is tested for *perchlorate*.

Chlorate and Hypochlorite.

Chlorate prepared by the electrolytic process may be tested for traces of hypochlorite by adding to 100 cc. of a 1 per cent. solution, prepared in the cold, 5 cc. of a mixture of a 10 per cent. cadmium iodide solution and a starch solution. Traces of hypochlorite immediately produce a blue colour.

(Hypochlorites give a precipitate of silver chloride on addition of silver nitrate or sulphate, but the solution then contains silver chlorate.)

Iodide and Iodate.

Iodide is tested for by means of fresh (neutral) chlorine water and carbon disulphide (chloroform is generally acid). Liberation of iodine on acidifying in presence of an iodide, indicates *iodate* (in absence of other oxidising agents).

Chlorate and Nitrate.

Solution is boiled with caustic soda to free from ammonium salts, aluminium dust added, and solution boiled. Evolution of ammonia indicates *nitrate* (also given by nitrite). Solution is acidified, and tested for chloride, the presence of which indicates *chlorate* in absence of chloride in the original (if present, chloride is eliminated by means of silver sulphate).

Nitrite and Nitrate.

Moderate amounts of *nitrite* are readily detected by means of potassium permanganate or iodide in presence of sulphuric acid.

On acidifying a solution of ferrous sulphate with dilute sulphuric acid and carefully pouring the solution on to the surface, a brown ring is formed in presence of a *nitrite*. The detection of *nitrate* by this test necessitates the use of concentrated sulphuric acid, and the test may be carried out after destroying the nitrite by boiling with ammonium chloride, or with a concentrated solution of urea in presence of sulphuric acid. (*Note.*—Traces of nitrate may be formed by oxidation during this process.)

Meta-phenylenediamine, or, better, the sulphanilic acid and α-naphthylamine reagent (see Reagents), is used for detecting *nitrite*.

Brucine may be used for detecting *nitrate* (see note above; the reaction between nitrite and concentrated sulphuric acid leads to the formation of traces of nitric acid). If the diphenylamine coloration is very decided after destroying the nitrite, the presence of *nitrate* may be assumed.

Separation of the Sulphur Acids.

Alkali sulphites, hydrosulphites, sulphides and polysulphides in weak alkaline solution decolorise aqueous solutions of magenta and of malachite green, or, better, a mixture of three volumes of 0·25 per cent. magenta solution and one volume of a 0·25 per cent. malachite green solution. The colour returns on addition of formaldehyde or acetaldehyde.

Bisulphides, thiosulphates and thionates do not decolorise the above dyestuff solution.

Carbon dioxide is passed into the solution until a drop gives practically no red colour with phenolphthalein. A portion of the solution is tested for *sulphide* with sodium nitroprusside. If present, it is removed by shaking with an excess of cadmium carbonate and filtering. A portion of the filtrate is then tested with the above dyestuff solution, when decolorisation indicates the presence of a *sulphite*; a further portion of the filtrate is acidified with dilute hydrochloric acid and boiled, when a precipitation of sulphur indicates the presence of a *thiosulphate*.

An alternative method is based on the solubility of barium *thiosulphate* and the insolubility of the *sulphate* and *sulphite*, the latter being identified by the addition of bromine water to the hydrochloric acid extract.

Sulphite and Carbonate.

The precipitation of barium sulphite prevents the direct detection of carbon dioxide by baryta water. The apparatus used for detection of traces of carbonate may be used for detection of carbonate in presence of sulphite, provided an extra wash-bottle containing a solution of potassium dichromate and dilute sulphuric acid (to remove sulphur dioxide) be interposed between the two boiling tubes.

Chromate and Dichromate.

An excess of barium chloride solution is added to precipitate barium chromate; an acid filtrate indicates a *dichromate*.

The dichromate may be precipitated by addition of methylene blue; further precipitate on addition of several drops of dilute sulphuric acid to the filtrate containing an excess of methylene blue indicates presence of a *chromate*.

II. Metallic Radicals (Cations).

PRELIMINARY TREATMENT OF SUBSTANCE IN PRESENCE OF PHOSPHATE, BORATE, SILICATE, FLUORIDE. OXALATE, Etc.

The presence of phosphate, borate, silicate, fluoride, and cyanide, and also of certain organic acids, *e.g.*, oxalic,

tartaric and citric acids, interferes with the group tests, and hence these acids may be removed before proceeding to Group III (except cyanides, which are removed before commencing the group tests), as follows :

Silicate. The substance is evaporated with concentrated hydrochloric acid, and finally heated in an air oven to 150°C. to render the silica insoluble. The residue is then extracted with dilute hydrochloric acid.

Phosphate is removed from Group III precipitate by one of the following methods :

(1) The precipitate is boiled with caustic soda, and filtered. Ammonium chloride is added to the filtrate, which is then boiled. White precipitate indicates *aluminium.* The precipitate is washed and dissolved in the smallest possible amount of dilute hydrochloric acid, ammonium carbonate added to the cold solution until it becomes turbid, and very dilute hydrochloric acid added drop by drop until it becomes clear. An equal volume of ammonium acetate solution is added, and then ferric chloride drop by drop until a reddish liquid is obtained. The solution is boiled for several minutes and filtered.

The precipitate is examined for *aluminium* and *chromium* by the usual Group III separation. The filtrate is boiled with ammonia and ammonium chloride, filtered, any precipitate obtained examined for *chromium,* and the filtrate added to that for Group IV.

The original substance is examined for *iron* as suggested in Group III separation table.

(2) The filtrate from Group II, after removal of sulphuretted hydrogen, is evaporated to dryness three times with 10 cc. of concentrated nitric acid to remove hydrochloric acid, dissolved in 10 cc. of nitric acid and 1 grm. pure tinfoil added. When the action has ceased, the mixture is poured into 100 cc. of cold water and allowed to stand over-night. The clear liquid is siphoned off, and used for Group III.

Fluoride and *cyanide* are removed by evaporating substance with concentrated sulphuric acid in a platinum capsule.

Oxalate, tartrate, and other non-volatile organic substances are destroyed by igniting the substance in a platinum capsule, extracting the carbonates formed by means of concentrated hydrochloric acid, moistening the residue with concentrated ammonium nitrate solution, and then continuing to heat until all carbonaceous matter has burnt off, any insoluble residue being fused with potassium bisulphate.

THE SEPARATION OF THE GROUPS.

(N.B.—The colours of the precipitates formed are only indications of the nature of the radicals present, as the presence of one metallic radical may cause the masking of the colour of the precipitate given by another metallic radical).

I. Acidify with HCl.

II. Pass H_2S into so'n.

Warm precipitate with ammonium sulphide

Oxidise soln. with bromine water.
Eliminate phosphates, etc.
III. Add NH_4Cl and NH_4OH.

IV. Pass H_2S into soln.

V. Add ammonium carbonate to filtrate.

White ppt. LEAD SILVER, or MERCUROUS	Residue (1) Soluble in HNO_3: Yellow ppt. CADMIUM Black ppt. BISMUTH, COPPER, or LEAD (2) Insol. in HNO_3: Black ppt. Sol. in HCl + $KClO_3$, MERCURIC	Filtrate On acidifying with HCl: Orange ppt. ANTIMONY Brown ppt. STANNOUS Yellow ppt. STANNIC Bright yellow ppt. ARSENIC	Brown ppt. IRON Violet or green ppt. CHROMIUM White ppt. ALUMINIUM	Ppt. (1) Sol. in HCl. White ppt., frequently discolored, ZINC Pink ppt. MANGANESE (2) Insol. in HCl, sol. in conc. HCl + $KClO_3$ Black ppt. COBALT or NICKEL	White ppt. CALCIUM, STRONTIUM, or BARIUM	VI. Add sodium phosphate to soln., White ppt. MAGNESIUM In original substance: SODIUM and POTASSIUM by flame tests. AMMONIUM by NaOH
Group I.	Group II.	Group IIA.	Group III.	Group IV.	Group V.	Group VI.

Test for Ammonium Salts.

An excess of caustic soda is added, and the solution warmed. Evolution of ammonia indicates presence of an ammonium salt.

Group I

In presence of an arsenate, chromate, dichromate, manganate, or permanganate, reduce with sulphur dioxide, and boil off the excess. Acidify solution with hydrochloric acid.*

Filter and reserve *filtrate* for Group II.

Extract white *precipitate* with hot water, and filter hot.

Residue.	Filtrate.
Wash with hot water until filtrate gives no ppt. with silver nitrate soln. Treat residue with ammonia, and filter immediately.	White crystals may separate on cooling. Add potassium chromate and sodium acetate to soln. Yellow ppt., soluble in caustic soda: LEAD.

Residue.	Filtrate.
Wash, and dissolve in dilute hydrochloric acid to which has been added a crystal of potassium chlorate, and almost neutralise with caustic soda. Boil with a piece of copper foil. Metallic deposit, gives mirror of globules of mercury on heating in an ignition tube: MERCURY(-OUS).	Acidify with nitric acid. White curdy ppt., filter, residue soluble in sodium thiosulphate soln., the soln. darkening on heating: SILVER.

* White ppt., sol. in excess, indicates bismuth or antimony, or the presence of aluminate, stannate, antimonate or zincate. Ppt. of sulphur indicates presence of a thiosulphate or polysulphide Gelatinous ppt. indicates an alkali silicate. Amorphous ppt., white when cold and yellow hot, indicates an alkali tungstate. White ppt., soluble in hot water, will be obtained in presence of much borate. Complex cyanides give a ppt. of an insoluble simple cyanide.

Evaporate to dryness and use hydrochloric acid extract for Group II.

Group II.

Warm *filtrate* from Group I, pass in a slow current of hydrogen sulphide, filter, dilute somewhat, and pass hydrogen sulphide into the warm filtrate. Filter, if necessary, through same filter paper, and reserve *filtrate* for Group III. Light yellow precipitate of sulphur indicates presence of an

oxidising agent (ferric salt, hydrogen peroxide, etc.). Wash precipitate with fresh hydrogen sulphide solution, rejecting filtrate, and then warm with 5 cc. of yellow ammonium sulphide. Filter, and reserve *filtrate* for Group II*a*.

Wash residue with water containing ammonium sulphide, and then with fresh hydrogen sulphide solution, rejecting filtrates. Digest the precipitate in an evaporating basin with 5 cc. of nitric acid (1 :1). Dilute somewhat, and filter.

Residue.
Pierce the filter-paper, and wash ppt. into an evaporating dish with 1 cc. of water and then with 5 cc. of warm, dilute hydrochloric acid to which has been added a crystal of potassium chlorate. Evaporate to 2 cc., filter if necessary, and add stannous chloride solution to the filtrate. White or grey ppt. :
MERCURY(-IC).

Filtrate.
Evaporate to 2-5 cc. in an evaporating dish, add 5 cc. dilute sulphuric acid, and evaporate almost to dryness. Stir residue with 5 cc. of cold dilute sulphuric acid, and filter.

White ppt.
Soluble in ammonium acetate solution, reprecipitated on addition of sulphuric acid :
LEAD.

Filtrate.
Add a slight excess of ammonia, and filter.

White ppt.
Solution in hydrochloric acid gives on addition of water a white ppt. :
BISMUTH.

Blue filtrate :
COPPER.
In presence of copper, acidify with dilute sulphuric acid, and boil with iron wire. Filter rapidly from precipitated copper, etc. Pass hydrogen sulphide into filtrate. Yellow ppt. :
CADMIUM.

Note.—Traces of copper are best detected by evaporating some of the *original* substance almost to dryness with dilute sulphuric acid, filtering if necessary, and then adding 1 cc. of a dilute solution of titanous sulphate to the filtrate. Pink opalescence or precipitate of metal indicates presence of copper. (Black precipitates are obtained in presence of arsenic or platinum; a purple solution is obtained in presence of gold.)

Group IIa.

Dilute *filtrate*, obtained by warming precipitate with ammonium sulphide in Group II, with an equal volume of water, and acidify with dilute hydrochloric acid. Boil, allow precipitate to settle, and decant off as much liquid as possible. Filter and wash the precipitate, rejecting the filtrate.

Warm the precipitate, which contains sulphur, with ammonium carbonate solution, adding solid ammonium carbonate if necessary, and filter.

RESIDUE.

Boil with concentrated hydrochloric acid. If necessary filter from sulphur after dilution. Concentrate to a very small volume, and place several drops of liquid on a piece of suitably bent platinum foil, on which is a fragment of zinc foil. After some seconds remove the zinc.

Black stain on platinum foil, insoluble in hydrochloric acid, but soluble in ammonium sulphide, the solution leaving an orange residue on evaporation :

ANTIMONY.

Place zinc and platinum foil in test-tube with remainder of liquid, and after hydrogen has been evolved rapidly for a short time, filter if necessary, and add mercuric chloride solution to filtrate. White or grey ppt. :

TIN.

FILTRATE.

Acidify with hydrochloric acid, filter, and wash ppt. Pierce filter-paper, wash ppt. into an evaporating dish, and dissolve in concentrated nitric acid. Evaporate almost to dryness, add sulphur dioxide solution and then 5 cc. of cold dilute hydrochloric acid, and a piece of copper foil, and warm. Metallic deposit (*Reinsch's test*), gives white sublimate on heating in ignition tube :

ARSENIC.

(An alternative method is to dissolve the ppt. of arsenic sulphide by warming with hydrogen peroxide and ammonia. Boil, and add ammonium chloride and magnesium chloride. White crystalline ppt. indicates *arsenic*).

Marsh's Test. Traces of *arsenic* and *antimony* are detected by pouring into a hydrogen generator the solution obtained by evaporating the nitric acid solution just to dryness and dissolving in cold hydrochloric acid. The arsenic and antimony hydrides burn with the hydrogen. The production of a brown stain, soluble in hypochlorite, on a cold porcelain crucible lid held in the flame, indicates the presence of *arsenic*. In case the stain does not dissolve readily in hypochlorite, it indicates the presence of *antimony*. (Nitrates, chlorates, etc, must be absent in this test.)

An alternative method of detecting *antimony* or *tin* in the residue is as follows: Boil the solution in hydrochloric acid with iron wire for several minutes, filter off precipitated antimony, etc., and add mercuric chloride to filtrate to test for *tin*. Dissolve residue in hydrochloric acid (1 : 1) containing a small crystal of potassium chlorate, boil, dilute somewhat, and pass in hydrogen sulphide. Orange precipitate indicates presence of *antimony*.

Group III.

Phosphates, etc., must be removed before proceeding to Group III.

Oxidise *filtrate* from Group II with bromine water, boil off the excess, and add a few cc. of ammonium chloride and an excess of ammonia.

Filter immediately, and reserve *filtrate* for Group IV. Wash precipitate, pierce the filter-paper, and wash precipitate into a boiling tube. Add sodium peroxide in small amounts, boil for two or three minutes, allow to cool, dilute somewhat, and filter.

RESIDUE.

Dissolve in dilute hydrochloric acid, and add potassium ferrocyanide solution.

Blue ppt.:

IRON.

Test original substance in hydrochloric or sulphuric acid solution with:

(a) Potassium ferrocyanide solution:

Blue ppt.: FERRIC.

(b) Potassium ferricyanide solution.

Blue ppt.: FERROUS.

FILTRATE.

Add ammonium sulphate solution and filter.

White gelatinous ppt., gives light blue mass on heating with cobalt nitrate on charcoal:

ALUMINIUM.

Yellow filtrate. Boil with excess caustic soda until free from ammonia.

Acidify with acetic acid. and add silver nitrate solution. Red ppt.

CHROMIUM.

Group IV.

Add ammonium sulphide to two drops of *filtrate* from Group III. In case a precipitate is obtained, warm remainder of *filtrate*, and pass a current of hydrogen sulphide, filter, and reserve *filtrate* for Group V. Wash precipitate several times with water containing ammonium sulphide and then with cold dilute hydrochloric acid.

RESIDUE

Test by borax bead for
COBALT and NICKEL

As the presence of a small amount of cobalt will mask the presence of even large amounts of nickel in the borax bead, pierce filter-paper, and dissolve ppt. in hydrochloric acid to which has been added a crystal of potassium chlorate. Evaporate almost to dryness. Dissolve the residue in 5 cc. of water, add an equal volume of ammonium chloride soln., and several drops of ammonia.

Divide soln. into two portions:

To one portion add 1 cc. of a soln. of the sodium salt of α-benzildioxime (or an alcoholic soln. of α-dimethylglyoxime). Pink ppt.:
NICKEL.

To the other portion add 1 cc. of a soln. of the sodium salt of α-nitroso-β-naphthol. Orange coloration, or ppt., not destroyed by just acidifying with dilute sulphuric acid:
COBALT.

FILTRATE.

Boil with an equal volume of caustic soda solution. Filter.

RESIDUE.

Test by borax bead for
MANGANESE.

Confirm by converting into permanganate by digesting with potassium persulphate and a few drops of silver nitrate.

FILTRATE.

Acidify with acetic acid and pass in hydrogen sulphide. White ppt., becomes green on heating with cobalt nitrate on charcoal:
ZINC.

(*Note.*—Traces of *nickel* in cobalt salts may be detected by adding concentrated ammonia soln., oxidising with hydrogen peroxide, boiling to destroy the excess, and then adding the nickel reagent. After filtering, the residue is washed with hot water. Pink residue indicates presence of *nickel*).

Group V.

If *filtrate* from Group IV is brown, due to presence of nickel, acidify with acetic acid, warm, and filter.

In case solution is not quite clear, add bromine water to oxidise suspended sulphur, and boil off the excess. (This is to be avoided if possible as it may cause the precipitation of traces of barium sulphate, etc.)

Concentrate the solution to 5 cc., and to the clear solution add an excess of ammonia and then ammonium carbonate, warm to about 60–70°C., filter, and reserve *filtrate* for Group VI.

Wash residue with water, and then treat with dilute nitric

acid, collecting filtrate in an evaporating basin. Evaporate filtrate *just* to dryness.

(1) Dissolve a *small portion* of residue in water, and add calcium sulphate solution :—

No ppt. even on standing.	Calcium may be present. Barium and strontium absent.
Gradual formation of ppt.	Strontium present; possibly also calcium. Barium absent.
Immediate ppt.	Barium present; possibly also strontium and calcium.

Calcium may be confirmed by freeing *another* small portion of residue from barium and strontium, if present, by adding dilute sulphuric acid to the solution in water, allowing to stand for several minutes, filtering, and then adding ammonia and ammonium oxalate to the filtrate. White ppt. indicates *calcium*.

(2) In case addition of calcium sulphate produces a precipitate, the remainder of the residue is stirred with three or four portions of 2-3 cc. of alcohol (95 per cent.), decanting the alcohol through a filter-paper moistened with alcohol.

Residue.	Filtrate.
Dry, add 3 cc. concentrated hydrochloric acid, and evaporate to dryness; repeat addition and evaporation. Treat dry residue several times with alcohol (95 per cent.). Filter.	Evaporate portion to dryness, and examine by flame coloration for CALCIUM. To remainder add ammonia and ammonium oxalate. White ppt. : CALCIUM.

Residue.	Filtrate.
Examine by flame coloration for BARIUM. Dissolve in water, and add potassium dichromate and sodium acetate. Yellow ppt. : BARIUM.	Evaporate to dryness, and examine residue by flame coloration for STRONTIUM.

Group VI.

(1) To approximately half of the *filtrate* from Group V add a small amount of ammonia, and ammonium chloride, if necessary, to dissolve any precipitate formed. Add sodium phosphate and a few cc. of concentrated ammonia solution. Allow to stand for some time if precipitate is not formed immediately.

White crystalline ppt. MAGNESIUM.

(2) Evaporate a small portion of the *filtrate* from Group V to dryness, and examine by flame coloration for POTASSIUM, SODIUM, and LITHIUM. Confirm by testing *original* substance.

(3) Evaporate the remainder of the solution to dryness in a porcelain or platinum dish and gently ignite the residue to expel ammonium salts. Dissolve the residue in a small amount of water, disregarding any residue of basic magnesium salt, and add barium hydroxide solution until strongly alkaline. Heat to boiling, filter, make the filtrate just acid with hydrochloric acid, and precipitate the barium with ammonia and ammonium carbonate. Filter, evaporate the filtrate to dryness, heat the residue gently to expel ammonium salts, take up with water, and repeat the precipitation with ammonium carbonate, filter, evaporate to dryness and remove ammonium salts. Dissolve the residue in a small amount of water, filter and evaporate the filtrate to dryness. (None of these operations should be performed in glass owing to the danger of extracting alkalis.) Add to the residue 10 cc. of 2N perchloric acid, and evaporate carefully until dense fumes of perchloric acid are evolved. Cool and add 20 cc. of alcohol. (If the perchloric acid-ammonia solution be heated there is extreme danger of a violent explosion). If necessary, add 2–3 cc. more perchloric acid, stir gently, and filter. Wash the ppt. with alcohol. Pass dry hydrochloric acid gas through the alcoholic filtrate to saturation, filter off the precipitated sodium chloride, wash with alcohol, and dissolve the residue in 1 cc. water. Add 2 cc. potassium pyroantimonate solution, and allow to stand over-night. A *crystalline* ppt. indicates sodium.

(The pyroantimonate solution is prepared by treating 20 grms. of the commercial salt with a litre of boiling water, boiling till nearly all the salt has dissolved, cooling quickly, adding 30 cc. KOH and filtering.)

Examine *original* substance for potassium as follows :

Boil with a solution of sodium carbonate (free from potassium) until free from ammonium salts, filter, add a

slight excess of acetic acid to the filtrate and then a recently prepared one per cent. solution of sodium cobaltinitrite.

Yellow ppt. POTASSIUM.

An alternative method is to add a strong solution of sodium acetate, and then tartaric acid. White crystalline precipitate, best obtained by shaking in presence of alcohol, indicates POTASSIUM.

Notes on the Group Separations.

In order that arsenates, chromates, etc., should be precipitated in the course of the groups, it is essential to reduce with sulphur dioxide to arsenites, chromic salts, etc.; otherwise chromate might give a green precipitate in Group II, and arsenic would only be precipitated, together with much sulphur, after a slow reduction with hydrogen sulphide. As this leads to the production of sulphuric acid in the solution, and hence would cause the precipitation of the insoluble sulphates of lead, barium, etc., this method of treatment must be avoided in presence of these metals. In such cases chromate is reduced by boiling with hydrochloric acid and alcohol, and arsenate by hydrogen sulphide, taking great care to ensure its complete reduction and removal (see notes on Group II).

Group I.

Silver chloride dissolves in ammonia to form the complex salt: $[Ag(NH_3)_2]Cl$, whereas mercurous chloride gives the insoluble compound $Hg(NH_2)Cl$ mixed with metallic mercury.

Owing to the slight reducing action of mercurous chloride in presence of ammonia, a small quantity of silver might not be detected in presence of large amounts of mercurous chloride, as it would remain insoluble as metallic silver. This may be prevented by oxidising the mixture of the two chlorides with bromine water, when only the silver chloride remains undissolved. Mercury is detected in the filtrate by means of stannous chloride.

The solubility of silver chloride in sodium thiosulphate depends upon the formation of a complex ion:

$$2AgCl + 3Na_2S_2O_3 = Na_4[Ag_2(S_2O_3)_3] + 2NaCl.$$

On warming in presence of an excess of thiosulphate, the black silver sulphide is produced.

Group II.

Care must be taken not to have the solution too strongly acid, as this prevents the precipitation of cadmium sulphide. On the other hand, the solution must contain a moderate

amount of hydrochloric acid, to prevent the formation of a colloidal suspension of arsenic sulphide, and to keep bismuth and antimony in solution. It has been found that arsenic is most readily precipitated if the concentration of hydrochloric acid is above 2N, whereas the concentration of the acid must be below N/2 to obtain complete precipitation of other members of this group, notably cadmium, antimony, and tin. To prevent metals of later groups from being precipitated, the concentration of acid must be above N/8.

On passing hydrogen sulphide into the solution, mercuric salts may give a white precipitate of a chlorsulphide which passes through yellow and brown to black, and lead salts frequently give a reddish precipitate of chlorsulphide which becomes black on warming and further saturating with hydrogen sulphide.

As copper sulphide is somewhat soluble in yellow ammonium sulphide, the titanous sulphate test must be carried out with the *original* substance (in absence of nitric acid), unless sodium sulphide is used, in which the copper sulphide is not soluble.

An alternative delicate test for copper is given by the precipitation of its ferrocyanide in acetic acid solution.

Group IIa.

Yellow "ammonium sulphide" contains polysulphides, thiosulphate, etc.

The solubility of the sulphides of this group in ammonium sulphide is due to the formation of the salts of complex thio-acids, *e.g.*, ammonium thioarsenite, $As(SNH_4)_3$. The solution should not be boiled as it is liable to lead to the precipitation of the red oxysulphide of antimony (Sb_2S_2O) by oxidation of the thioantimonite $Sb(SNH_4)_3$. In case yellow ammonium sulphide is used, ammonium thioantimonate is produced :

$$Sb_2S_3 + 2(NH_4)_2S_2 = SbS(SNH_4)_3 + SbS_3NH_4.$$

Stannous sulphide is not soluble in colourless ammonium sulphide, but is converted into the soluble stannic compound by yellow ammonium sulphide. On this account it is necessary to test in the *original* substance for the condition of the tin as follows :

A solution is prepared in the cold containing hydrochloric acid. Mercuric chloride is added, when white or grey precipitate indicates presence of a *stannous* compound; in case no precipitate is obtained, the presence of a *stannic* compound may be assumed.

The metallic deposit obtained on the copper foil is probably an arsenide, Cu_5As_2.

Group III.

Before adding the group reagent, it is necessary to oxidise any ferrous salt present, which may have been produced from a ferric salt by hydrogen sulphide. It follows that the tests for ferrous and ferric ions must be carried out with the *original* substance. Fresh solutions of potassium ferrocyanide and ferricyanide should be used, as these solutions decompose on standing. In case iron has been found to be present, but neither of these reagents gives any reaction, the presence of the iron as ferrocyanide or ferricyanide may be suspected.

Before oxidising, as much hydrogen sulphide as possible should be removed by boiling, to avoid its oxidation to sulphuric acid, which might cause the precipitation of barium, etc. In case the solution is not quite clear after boiling with an excess of bromine water, it is filtered, and the residue examined by flame coloration (as suggested for barium sulphate, see "Dry-way tests").

It is essential to free completely from bromine, as otherwise a hydrated manganese oxide will be precipitated on addition of ammonia. In presence of much nitric acid (hence the advantage of using bromine water), or even on exposure of the warm ammonia solution to air, manganese may be precipitated as a brown powder, readily distinguished by its character from ferric hydroxide.

The addition of ammonium chloride is necessary to keep magnesium, etc., in solution, and also to render the precipitation of aluminium hydroxide more complete (probably due to the conversion of the colloidal solution (*aqua sol*) of aluminium hydroxide into the insoluble *gel*). Even in presence of ammonium chloride, it is essential to boil for several minutes to complete the precipitation of chromium.

On boiling with sodium peroxide, chromium hydroxide is oxidised to chromate, and the aluminium hydroxide dissolves in the caustic soda formed to give sodium aluminate. Addition of ammonium sulphate to the filtrate frees the solution from caustic alkali, forming ammonia, in which the aluminium hydroxide is not soluble.

As caustic soda frequently contains aluminate and silicate, it is advisable to carry out a "blank" on the caustic soda solution in case only traces of aluminium are found. A confirmatory test for aluminium is as follows: Filter off the hydroxide and suspend it in water containing *one* drop of dilute acetic acid, boil for several minutes, and then add to

the suspension one cc. of an alcoholic solution of alizarin (5 drops of the 20 per cent. paste in 50 cc. of alcohol). Red coloration confirms presence of aluminium. This test is more delicate than precipitation as hydroxide, but would be interfered with by many other metals (including iron and chromium); as the coloration is destroyed by acids, the solution would require careful neutralisation, and it is preferable to use a suspension of the hydroxide as suggested.

The necessity for removing phosphate is due to the phosphates of certain metals of later groups being soluble in hydrochloric acid, but being reprecipitated on addition of ammonia. Hence they would appear in Group III, *e.g.*, calcium phosphate might be mistaken for the aluminium hydroxide precipitate.

For similar reasons fluorides must be removed before proceeding to Group III; for example, precipitated calcium fluoride is soluble in hydrochloric acid, but would be reprecipitated on addition of ammonia. As is also the case with borates, fluorides would only be precipitated incompletely in Group III, and metals present as borates or fluorides may frequently be identified as usual in the later groups.

The method of separating phosphate as a basic tin phosphate before proceeding to Group III is more satisfactory than separating as basic ferric phosphate in presence of chromium, but manganese is carried down with the precipitate, which is often difficult to filter.

The removal of organic acids before Group III is necessary owing to their tendency to form complex ions with ferric, aluminium, etc., salts which do not give a precipitate with ammonia. Thus aluminium hydroxide is soluble in neutral tartrates, forming a compound containing a complex negative ion.

Oxalates must be removed, as addition of ammonia would precipitate calcium, strontium and barium as oxalates in Group III.

As ammonium carbonate is frequently present in the ammonia, traces of Group V metals may be carried down in this group; in such a case, dissolve the precipitate in dilute hydrochloric acid, and re-precipitate by adding ammonia drop by drop. The ammonia should also be tested for sulphate, which would precipitate metals of Group V.

Note.—In presence of large amounts of cobalt, or if small amounts of zinc are to be detected, it is necessary to precipitate the metals of Groups III and IV together, by

adding ammonia and ammonium chloride and then passing in hydrogen sulphide, filtering, and washing with water containing ammonium sulphide.

Cobalt and nickel are obtained as sulphides insoluble in cold 10 per cent. hydrochloric acid, whereas the remainder of the precipitate is soluble. The filtrate is then oxidised with bromine, and iron, chromium, and aluminium hydroxides precipitated by almost neutralising with sodium carbonate, adding precipitated barium carbonate and then allowing to stand, with occasional shaking, for one hour. The precipitate is filtered off, and examined as in the usual Group III separation. The solution contains manganese, zinc, and traces of barium (from the barium carbonate), and is examined for manganese and zinc as Group IV separation.

A disadvantage of this joint method of precipitation is that phosphates of the metals of later groups may be precipitated, and cause difficulties in the separation. Phosphates of the metals of Group IV will have been converted into sulphides by digesting with ammonium sulphide.

Group IV.

It is advisable to use hydrogen sulphide in this group, as ammonium sulphide frequently contains sulphate, which would cause the precipitation of barium, etc. The use of hydrogen sulphide further avoids the dissolution of nickel sulphide, which is not soluble in colourless ammonium sulphide.

In presence of much ammonia, it is necessary to boil for some time to effect complete precipitation of the manganese sulphide.

Although nickel and cobalt sulphides are insoluble in dilute hydrochloric acid, they are not precipitated in Group II. This behaviour is ascribed to a change in the state of aggregation of these sulphides immediately after precipitation.

As cobalt and nickel sulphides oxidise rapidly to the soluble sulphates, it is necessary to wash with water containing ammonium sulphide, and to avoid exposing the precipitate to air. Traces of nickel generally pass into the solution with the zinc and manganese.

As manganese sulphide is soluble in acetic acid, zinc and manganese may be separated in this manner.

Group V.

As a fresh solution of ammonium *carbonate* contains *bicarbonate* and *carbamate*, it is advisable to warm to 60-70°C. (but not above this temperature) to ensure the hydration of the carbamate :

$$CO\begin{matrix}\nearrow NH_2\\ \searrow ONH_4\end{matrix} \quad + \quad H_2O \quad = \quad CO\begin{matrix}\nearrow ONH_4\\ \searrow ONH_4\end{matrix}$$

and decomposition of the bicarbonate.

As the reaction :

$$CaCl_2 + (NH_4)_2CO_3 = 2NH_4Cl + CaCO_3$$

is reversible, it is essential to use a large excess of ammonium carbonate and to warm only until the precipitate has become crystalline. In presence of much ammonium chloride, which is essential if magnesium is present, the precipitation of small amounts of calcium is incomplete, or may not take place at all. In case the presence of calcium has been indicated by the flame coloration test, but no precipitate is obtained with ammonium carbonate, a portion of the solution should be warmed and treated with ammonium oxalate, and any precipitate obtained examined for calcium by the flame coloration test.

Magnesium is frequently carried down in this group, and a careful reprecipitation must be carried out if traces of magnesium are to be detected in Group VI.

Group VI.

In case the separation of aluminium, calcium, barium, etc., has not been complete, a *flocculent* precipitate may be obtained on addition of sodium phosphate. These metals may be removed completely from the filtrate from Group V by adding a large amount of ammonium chloride, and then ammonium sulphate and oxalate, and boiling for several minutes. On addition of sodium phosphate to the filtrate, the production of a *crystalline* precipitate indicates the presence of magnesium.

As traces of sodium and potassium salts will probably have been introduced with the group reagents, it is essential to confirm in the *original* substance, although it is to be remembered that other elements may be present in this which will mask the potassium flame coloration.

EXAMINATION OF INSOLUBLE SUBSTANCES.

The substances which are insoluble or practically insoluble in single mineral acids, but are soluble in *aqua regia*, are: mercuric sulphide, antimony oxide, stannic sulphide, sulphur, and, after continued treatment, Prussian blue.

The substances which are insoluble or practically insoluble in mineral acids, including *aqua regia*, are: silver chloride, bromide, iodide and cyanide; sulphates of barium, strontium and lead; calcium fluoride; fused lead chromate; fused chromic oxide and chrome iron ore; stannic and titanic oxide ores; alumina; silica and many silicates; carbon; and carborundum. In addition, insoluble substances may contain combined phosphate, borate, sulphate, chloride or fluoride, which will not be found by the usual tests.

The general method of treatment is to fuse with fusion mixture, and extract the melt with hot water, and then with dilute acids.

Ignited ferric oxide, chromic oxide, and alumina, are very difficult to dissolve in acids, and are best fused with potassium bisulphate, or with acid potassium fluoride, a method of treatment which is the most satisfactory for the solution of many minerals.

Platinum vessels are attacked by easily reducible metals, such as lead, silver, and bismuth, and also by caustic alkalies. If porcelain vessels are used for the fusion, silica, alumina, etc., will be introduced. Consequently in presence of lead, etc., the acid fluoride method is used.

In case the insoluble substance has not already been examined by the dry-way tests, these tests should be carried out, as they generally give an indication of the substance under examination. According to the results obtained, one of the following methods is attempted for effecting solution if necessary for complete identification.

(1) Insoluble silver halides are dissolved by a solution of sodium thiosulphate, the solution darkening on heating. For complete identification, they are reduced in contact with zinc and dilute sulphuric acid to metallic silver. After filtering, the filtrate is tested for the halogen acid; the residue is dissolved in dilute nitric acid, and hydrochloric acid added to test for silver.

(2) Insoluble barium, strontium, and calcium sulphates, silica and silicates should be fused with five times the amount of fusion mixture on platinum foil for several minutes, and the mass plunged into water whilst still hot.

After crushing with a glass rod and heating to the boiling-point, the liquid is filtered, and the residue washed with hot water and then treated with dilute hydrochloric acid. The aqueous and acid extracts are then examined for acid and metallic radicals respectively. The formation of a gelatinous precipitate on acidifying the aqueous solution indicates silica or silicate.

Sodium and potassium are detected in silicates after fusing with ammonium fluoride.

Silicon and ferro-silicon are dissolved by fusing with caustic soda.

An alternative method for insoluble sulphates is to confirm the sulphate by boiling with concentrated sodium carbonate solution, extract the residue with hydrochloric acid, and examine the solution for metallic radicals.

(3) Stannic and titanic oxide ores may be brought into solution by fusing with caustic soda in a silver or nickel dish. In the case of chrome iron ore, sodium peroxide should be added. The melt is extracted with water and the residue dissolved in hydrochloric acid.

Tin ores may be brought into solution by reducing to a fine powder, moistening with commercial hypophosphorous acid, and heating to dryness at a temperature not exceeding 240°C. The residue is extracted with hydrochloric acid, and tested for tin.

(4) Calcium fluoride may be identified by fusing with potassium bisulphate on platinum foil, and subsequently examining by the flame test.

(5) Insoluble complex cyanides are decomposed readily by digesting with caustic soda solution in a porcelain dish.

EXAMINATION OF AN ALLOY.

As it is not necessary to examine for acid radicals, the analysis of an alloy is much simpler than that of a mixture of salts. The main difficulty met with is in dissolving the alloy. As certain electronegative elements (carbon, silicon, phosphorus, and sulphur) are frequently present in small quantities, it is inadvisable to attempt to dissolve an alloy in hydrochloric acid, as volatile hydrides would be formed from carbides, silicides, phosphides, sulphides and arsenides, forms in which these electronegative elements are frequently present. It is hence convenient to dissolve in an oxidising agent, such as nitric acid. In the case of the ferro-alloys, a powdered sample may be fused with potassium bisulphate and persulphate.

Warm fragments of alloy with nitric acid (1 : 1). Dilute with twice the volume of water. A dark-coloured solution indicates the presence of *carbon*. Filter. If completely dissolved indicates absence of *tin* and *antimony*

FILTRATE A.	RESIDUE
After addition of Filtrates B and C. examine by group tests for metals, and also for sulphate, phosphate. and arsenate, the presence of which indicates the presence of the corresponding element in the alloy.	(may contain tin, antimony, and bismuth, with traces of other metals; also phosphate). Pierce filter-paper, and wash precipitate into a test-tube. Add a small piece of caustic potash, and then 10 cc, of concentrated sodium sulphide solution, digest on a water-bath for 15 minutes, dilute and filter.

FILTRATE.	RESIDUE.
(may contain tin antimony or phosphate). Acidify with dilute hydrochloric acid and filter.	Extract with hot dilute nitric acid.

Filtrate (from acidifying with hydrochloric acid):

FILTRATE.	RESIDUE.
Test by ammonium molybdate for phosphate, the presence of which indicates PHOSPHORUS.	Examine for TIN and ANTIMONY (Group IIa).

Residue (after extracting with nitric acid):

FILTRATE B.	RESIDUE.
Add to Filtrate A.	Wash, dry, and fuse with caustic potash in a silver dish. Rinse into porcelain dish with hot water and extract with dilute nitric acid. Filter.

FILTRATE C.	
Add to Filtrate A.	Gelatinous residue indicates the presence of SILICON

REACTIONS OF CERTAIN OF THE "RARER" METALS.

After dissolving the powdered substance by fusion with potassium bisulphate, with the addition of persulphate if necessary, and subsequently extracting with cold water and then with concentrated hydrochloric acid, the liquid is diluted and filtered. Any residue may then be dissolved by fusing with caustic soda and sodium peroxide in a nickel crucible, extracting with hot water, afterwards boiling the solution to destroy the last traces of sodium peroxide. The solution is acidified with hydrochloric acid; the formation of a precipitate indicates the presence of tungsten or silicon.

Preliminary test. A small piece of zinc is introduced into a portion of the hydrochloric acid solution. After a brisk evolution of hydrogen has occurred for one minute, the liquid is decanted off the zinc, and, when quite free from undissolved zinc particles, two drops of a very dilute solution (N / 1000) of methylene blue are added. The blue colour is destroyed in presence of traces of titanium, vanadium, molybdenum, and tungsten. In case the colour of the methylene blue persists, it may be taken as final evidence of the absence of these metals from the solution.

Group I.

Tungsten.

The behaviour of a solution of an alkali tungstate is as follows :

(1) Mineral acids give a white precipitate which becomes yellow on heating. The white precipitate is soluble in phosphoric acid and in alkalies.

(2) Hydrogen sulphide does not give a precipitate in acid solution ; but, on addition of ammonium sulphide and then an acid, a light brown precipitate soluble in ammonium sulphide is obtained.

(3) Reducing agents give a blue solution.

(4) Lead and mercurous tungstates are formed as white insoluble precipitates.

Separation from Silicic Acid :

Tungstic acid only is soluble in ammonium carbonate.

Separation from Titanium :

Tungstic acid only is insoluble in dilute sulphuric acid.

Group IIa.

Note.—Although gold and platinum may be considered to belong to this Group, owing to the comparative difficulty with which their sulphides dissolve in yellow ammonium sulphide they are generally removed before proceeding to Group II. On heating with oxalic acid, gold is precipitated as such, and the platinum may be removed from the filtrate by evaporating with ammonium chloride to obtain the insoluble ammonium platinic chloride, and extracting the residue with alcohol (75 per cent.). The solution, freed from alcohol, is then used for Group II.

Gold.

The behaviour of a solution of chlorauric acid is as follows :

(1) With cold solutions containing gold, hydrogen sulphide gives a black precipitate of the disulphide, soluble with difficulty in yellow ammonium sulphide, but more soluble in yellow potassium sulphide. At the boil, hydrogen sulphide gives a brown precipitate of metallic gold, soluble in alkali polysulphides.

(2) Ferrous salts and oxalic acid reduce acid solutions giving a brown precipitate of gold. (*Compare* platinum.)

(3) Stannous chloride gives a brown precipitate with strongly acid solutions, and a purple solution or precipitate with faintly acid solutions (also given by titanous chloride).

(4) Hydrogen peroxide precipitates finely divided gold from alkaline solutions.

Platinum.

The behaviour of a solution of chlorplatinic acid is as follows :

(1) Hydrogen sulphide gives a dark-brown precipitate with hot solutions, soluble with difficulty in alkali polysulphides.

(2) Ammonium and potassium chloride give yellow, crystalline precipitates with concentrated solutions, or on addition of alcohol in the case of dilute solutions.

(3) Alkali iodides give dark-brown solutions

(4) Neither ferrous salts nor oxalic acid precipitate platinum from acid solutions. (*Compare* gold.)

(5) Stannous chloride gives a blood-red solution, the colour being extracted by ether.

Molybdenum

The behaviour of a solution of an alkali molybdate is as follows :

(1) Hydrogen sulphide gives a blue solution and then a brown precipitate soluble in ammonium sulphide. On oxidation in air or by concentrated nitric acid, the brown sulphide gives glistening needles of molybdic oxide, which is yellow whilst hot.

(2) On heating with several drops of concentrated sulphuric acid in a porcelain dish, and allowing to cool, an intense blue mass is formed.

(3) Reducing agents give a blue solution, which on further reduction with zinc and concentrated hydrochloric acid, becomes successively green, orange, and pink.

(4) Addition of potassium ferrocyanide to a solution containing a mineral acid gives a reddish-brown precipitate soluble in caustic alkalies and in ammonia. (*Compare* uranium.)

Separation from Arsenic, Antimony and Tin :

Fuse Group IIa precipitate with twenty times the amount of a mixture of equal parts of fusion mixture and sodium peroxide in a nickel crucible for ten minutes. Extract the sodium arsenate and molybdate with cold water, filter from the undissolved sodium antimonate and stannic oxide, and wash with caustic soda solution.

Acidify the filtrate with hydrochloric acid, make strongly ammoniacal, and precipitate the arsenate by addition of magnesia mixture. Examine concentrated filtrate for molybdenum.

The residue is dissolved in hydrochloric acid (1 : 1) and examined for antimony and tin as usual.

Group III.

Titanium.

The behaviour of a solution of a titanic salt is as follows :

(1) Ammonia and ammonium sulphide give a white, gelatinous precipitate.

(2) Caustic potash gives a white, gelatinous precipitate, insoluble in excess. (*Compare* aluminium.)

(3) Tin and zinc, but not hydrogen sulphide or sulphur dioxide (*compare* vanadium), reduce acid solutions to violet titanous salts.

(4) With hydrogen peroxide, titanium sulphate gives a colour similar to that of vanadium (3).

(5) Potassium ferrocyanide gives a brown precipitate from slightly acid solutions.

Separation from Iron, Aluminium and Chromium.

Add sodium carbonate to the cold solution (free from organic acids) until a slight precipitate is obtained. After dissolving precipitate in a few drops of sulphuric acid, dilute to a large volume with water, to hydrolyse the sulphate, and boil for half an hour. Filter, and wash the precipitated metatitanic acid with very dilute sulphuric acid. The precipitate dissolves slowly on digesting with concentrated hydrochloric acid.

Uranium.

The behaviour of a yellowish-green solution of a uranyl salt is as follows:

(1) Ammonia and caustic alkalies give a yellow, amorphous precipitate of a uranate, soluble in alkali carbonates, particularly in ammonium carbonate.

(2) Ammonium sulphide gives a brownish-red precipitate, soluble in dilute acids and in ammonium carbonate.

(3) Potassium ferrocyanide yields a brown precipitate, insoluble in mineral acids, which is turned yellow by caustic potash. (*Compare* molybdenum.)

Separation from Iron, Aluminium and Chromium.

Dissolve Group III precipitate in a small amount of dilute hydrochloric acid, make strongly alkaline with caustic soda, boil, dilute with hot water, and boil for several minutes. Filter hot from sodium aluminate solution, wash precipitate thoroughly with hot water. Warm precipitate with ammonium carbonate solution, but do not boil. Filter, and test for uranium in filtrate by acidifying and adding potassium ferrocyanide.

Group IV.

Vanadium.*

The behaviour of a solution of an alkali vanadate is as follows:

(1) Ammonium sulphide gives a red solution which on acidifying with dilute sulphuric acid gives a brown precipitate soluble in alkalies, and alkali carbonates and sulphides.

* Although vanadate solutions do not give a precipitate with ammonium sulphide, which first acts as a reducing agent, it is convenient to consider vanadium in Group IV.

(2) Hydrogen sulphide, sulphur dioxide, and other reducing agents give blue solutions.

(3) Hydrogen peroxide produces a reddish brown solution, the colour of which is not extracted by ether. (*Compare* chromate.)

(4) Lead and mercurous vanadates are insoluble in water but soluble in nitric acid.

Detection of Vanadium in Ores, etc.

Fuse with five times the weight of a mixture containing four parts of fusion mixture and one part of potassium nitrate. Extract with water and reduce any manganate formed with alcohol. Filter, and almost neutralise filtrate with nitric acid. Evaporate the alkaline solution almost to dryness, add water, and filter. Add mercurous nitrate solution, when any phosphate, arsenate, chromate, molybdate, tungstate, or vanadate present will be precipitated. Boil, filter, and dry precipitate. Ignite, fuse the residue with a small amount of sodium carbonate, and extract with water. Yellow solution indicates *chromium*. Acidify with sulphuric acid, and precipitate *arsenic* and *molybdenum* by means of hydrogen sulphide. Filter, and pass a current of carbon dioxide through filtrate at the boil. Test for *vanadium* in filtrate by Test (3) above.

Group VI.

Lithium.

(1) Neither chlorplatinic acid nor tartaric acid gives a precipitate. (*Compare* potassium.)

(2) On digesting in concentrated solution with sodium phosphate, a white precipitate of trilithium phosphate is obtained, which is fusible (distinction from magnesium and alkaline earth metals).

(3) On warming with ammonium carbonate and ammonia, concentrated solutions give a white precipitate of the slightly soluble carbonate. (*Compare* alkali carbonates.) In presence of large amounts of alkali chlorides or ammonium chloride, no precipitate is obtained.

Separation from Sodium and Potassium.

Of the anhydrous chlorides, only the lithium salt is soluble in ether-alcohol mixture and in amyl alcohol.

REAGENTS.

CONCENTRATED ACIDS AND ALKALIES.

Hydrochloric acid, Sp. Gr. 1·19	38%
Nitric acid, Sp. Gr. 1·40	65%
Sp. Gr. 1·20	32·5%
Sulphuric acid, Sp. Gr. 1·84	96%
Acetic acid, Freezing pt. 7° C.	93%
glacial, Freezing pt. 17° C. ...	98%
Ammonia, Sp. Gr. 0·880	30%
Sp. Gr. 0·905	27%

SATURATED SOLUTIONS.

At 15° C. 100 grm. of solution contain:

Chlorine water	0.73 grm. Cl.
Bromine water	3.66 grm. Br.
Hydrogen sulphide water	0.48 grm. H_2S.
Baryta water	5.95 grm. $Ba(OH)_2.8H_2O$
Lime water	0.17 grm. $Ca(OH)_2$.
Calcium sulphate solution ...	0.21 grm. $CaSO_4$.

SPECIAL REAGENTS.

Ammonium molybdate solution. 150 grm. of ammonium molybdate $[(NH_4)_6Mo_7O_{24}.4H_2O]$ are dissolved in a litre of water, and the solution poured into a litre of nitric acid (Sp. Gr. 1·2).

As a test for phosphate and arsenate, the reagent must be used in large excess, and the test is more delicate in presence of an equal volume of a concentrated solution of ammonium nitrate. In the case of arsenate the precipitate only forms rapidly on heating.

The yellow precipitate is the insoluble ammonium (or potassium) salt of phospho- or arseno-molybdic acid, which is soluble. The ammonium salt dissolves in alkalies, and addition of magnesium chloride to the solution gives a white crystalline precipitate of magnesium ammonium phosphate or arsenate.

Ammonium sulphide. Hydrogen sulphide is passed through 3 parts of ammonia solution until saturated, and 2 parts of the same ammonia solution are added. Yellow ammonium sulphide is prepared by digesting this solution with powdered (roll) sulphur.

Aqua regia, 1 volume of concentrated nitric acid mixed with 4 volumes of concentrated hydrochloric acid.

Cobalt reagent. *a*-Nitroso-*β*-naphthol is used in the form of its sodium salt, obtained by dissolving 0·1 grm. in 2 cc. of 2N caustic soda diluted to one litre.

Fehling's solution.

A. 34·64 grm. of $CuSO_4.5H_2O$ in 500 cc. of water.

B. 173 grm. of Rochelle salt and 50 grm. of caustic soda in 500 cc. of water.

Equal volumes are mixed just before use.

Hydrofluosilicic acid. Mixture of 1 part of calcium fluoride, 1 part of sand, and 6 parts of sulphuric acid is distilled, the leading tube dipping under mercury, on top of which is a layer of water. The solution is decanted and filtered.

Hydrogen peroxide. 2 per cent. solution (ten volumes of available oxygen).

Magnesia mixture. 100 grm. of $MgCl_2.6H_2O$ are dissolved in a litre of water, 250 grm. of ammonium chloride, and then 300 grm. ammonia (Sp. Gr. 0·880) added. After allowing to stand for several days the clear liquid is used.

Nessler solution. 35 grm. of potassium iodide and 12·5 grm. of mercuric chloride are dissolved in about 800 cc. of water. 120 grm. of caustic sode are dissolved in this, and the solution allowed to cool. Saturated mercuric chloride solution is then added drop by drop with constant stirring until a slight red precipitate remains. The solution is diluted to a litre, the precipitate allowed to settle, and the clear liquor siphoned off, and preserved in the dark.

The intensely coloured compound found in presence of ammonia is dimercuriammonium iodide, $NHg_2''I$.

Nickel reagents:

Dimethylglyoxime is used in 1 per cent. alcoholic solution, or in saturated aqueous solution, in which case the mixture must be allowed to stand to obtain the pink precipitate.

a-Benzildioxime is more easily prepared and is more delicate as a reagent for nickel. It is obtained by digesting an alcoholic solution of benzil with an equal weight of hydroxylamine hydrochloride. The precipitate obtained is washed twice with 50 per cent. alcohol. For qualitative purposes it is conveniently used in the form of the sodium salt, prepared by dissolving 0·1 grm. of the compound in

5 cc. of 2N caustic soda diluted to one litre. One cc. of this reagent is added to the solution under examination, which should contain ammonia and ammonium chloride.

Nitrite reagent (Ilosvay). 0·5 grm. sulphanilic acid is dissolved in 150 cc. of dilute acetic acid. 0·2 grm. of α-naphthylamine are extracted with 20 cc. of water, the colourless solution decanted, and 150 cc. of dilute acetic acid added. The two solutions are mixed, and preserved in the dark.

Sodium cobaltinitrite. A fresh 1 per cent. solution is used, and gives the yellow, crystalline $K_2Na[Co(NO_2)_6].H_2O$ in neutral or acetic acid solution.

Starch solution. The starch is ground with water to a thin cream, which is poured into sufficient boiling water to produce a 1 per cent. solution. The cold, clear solution is decanted for use. (After keeping for some time, the colour obtained with iodine is not so intense as with a fresh solution; it may, however, be preserved for a longer period by the addition of several drops of chloroform.)

IMPURITIES IN REAGENTS.

In the following notes, the more probable impurities which may be present in stated reagents are given.

Before testing for impurities, reagents must be diluted if necessary to a suitable concentration. Only tests of a special character have been inserted. Tests of a general character are:

(1) Volatile substances should leave no residue.

(2) Acid or alkaline reaction of a solid, which should give a clear solution if soluble in water.

(3) Test for heavy metals by means of ammonium sulphide.

As the testing of reagents is largely a matter of testing for *traces* of impurities, tests should be allowed to stand for several hours.

Acetic acid. Test for common mineral acids, and for copper, lead, iron, and calcium.

After mixing the dilute acid (1 : 3) with twice its volume of N/100 permanganate, the colour should remain after standing fifteen minutes.

Ammonia. Test for chloride and sulphate. Also for carbonate by warming with lime water, and for pyridine, etc., by almost neutralising the dilute solution (1 : 3) with dilute sulphuric acid, using methyl orange as indicator, when

the liquid obtained should be odourless. The concentrated solution should not give a yellow or pink coloration on acidifying with nitric acid (1 : 1).

Ammonium carbonate. Test for chloride, iodide, and sulphate. Test for organic matter by evaporating with an excess of nitric acid; the residue should be white.

Ammonium chloride. Test for sulphate, phosphate, thiocyanate, and organic matter (see *ammonium carbonate*).

A 5 per cent. solution should be neutral (even the purest commercial samples are acid, and contain traces of iron).

Ammonium fluoride. Test for sulphate. Acidity indicates presence of bifluoride. Lead generally present. On volatilisation, 10 grm. should give only 2-3 mgrm. residue.

Ammonium nitrate. See *ammonium chloride.*

Ammonium oxalate. Test for sulphate, free ammonia, free oxalic acid, and for potassium.

Ammonium sulphate. Test for chloride, nitrate, phosphate, thiocyanate, and arsenic.

Ammonium sulphide solution. Test for carbonate by warming with lime water, for free ammonia by warming with magnesium chloride, and for arsenic.

Ammonium thiocyanate. Test for chloride and sulphate. 1 grm. should dissolve completely in 10 cc. of alcohol. A 5 per cent. solution should remain colourless after addition of dilute hydrochloric acid. It is essential that the sample should be pure white, as yellowish samples contain organic matter. Traces of lead and iron, and of sulphuric acid are frequently present in commercial samples.

Barium carbonate. The filtrate obtained by adding sulphuric acid to a hydrochloric acid solution should not leave any residue on evaporation and ignition.

Barium chloride. Test for chlorate by warming 2 grm. with 10 cc. of concentrated hydrochloric acid. Commercial samples frequently contain traces of iron and potassium, and are moist, due to the presence of calcium chloride.

Barium hydroxide. Test for chloride. Commercial samples contain sulphate, sulphite, sulphide, and thiosulphate. Sample should be completely soluble in water, or leave only a slight residue of barium carbonate.

Barium nitrate. Test for chloride and for lead.

Bromine. Test for chlorine, iodine, sulphur and organic compounds (bromoform, etc.), as follows: Convert several grams into ammonium bromide by adding water and then slowly adding an excess of ammonia. A residue of oily drops indicates the presence of organic compounds. Traces of iodide are detected by adding ferric chloride and chloro-

form. Traces of chloride are detected by using the fact that silver chloride is soluble in warm ammonium sesquicarbonate solution (1 part of ammonium carbonate, 1 part of ammonia, Sp. Gr. 0.96, and 3 parts of water) whereas the bromide is practically insoluble, and the iodide is quite insoluble.

Calcium chloride. Test for sulphate, ammonium compounds, and iron. 1 grm. should dissolve completely in 10 cc. of alcohol. A 5 per cent. solution should remain clear on standing with calcium sulphate solution.

Calcium oxide. Test for chloride, sulphate, carbonate, silica, alumina and iron.

Copper sulphate. Test for iron and zinc.

Ferric chloride. Test for free hydrochloric acid, by bringing the stopper of an ammonia bottle near to the solid. Also for free chlorine with starch-iodide paper, and for arsenic, copper, ferrous chloride, sulphates and nitrates. Sample should be completely soluble in ether.

Hydrochloric acid. Test for sulphate, sulphurous acid, free chlorine, other halogen acids; and for iron, arsenic, aluminium, and calcium.

Hydrogen peroxide. Test for chloride, fluoride, hydrofluosilicate, sulphate, phosphate, alumina, magnesia, and free acid.

Iodine. Add ammonia to the aqueous extract and test for chloride and bromide. Test another aqueous extract for cyanogen by adding sodium thiosulphate until decolorised, then a crystal of ferrous sulphate, a drop of ferric chloride solution, and several drops of caustic soda; warm the solution and acidify with hydrochloric acid, when no blue colour should be developed.

Nitric acid. Test for sulphuric acid in the residue obtained by evaporating 10 cc. to 0·5 cc.; for hydrochloric acid by adding 10 cc. to 50 cc. of water containing several drops of silver nitrate solution; for iodine compounds (iodic acid, etc.) by diluting with an equal volume of water, adding a piece of zinc and then carbon disulphide to extract any iodine liberated; also test for iron and arsenic.

Oxalic acid. Test for sulphate, ammonia, sodium, potassium, calcium, and iron. The crystals should not have effloresced.

Phosphoric acid. Test for nitric acid, halogen acids, sulphuric acid, metaphosphoric acid, ammonia, and arsenic.

On boiling 5 cc. with 5 cc. of sulphuric acid and 5 drops of potassium permanganate (0.1 per cent.), the red colour

should persist after five minutes, indicating the absence of lower phosphorus acids and of organic matter.

Potassium bisulphate. Test for chloride, nitrate, and arsenic.

Potassium carbonate. Test for chloride, chlorate, nitrate, sulphate, phosphate, silicate, cyanide, sulphide, sodium and aluminium.

Potassium chlorate. Test for chloride, nitrate, sulphate, sodium, calcium, lead, and arsenic.

Potassium chloride. Test for sulphate, calcium, and manganese.

Potassium chromate. Test for chloride, sulphate, aluminium and calcium. Phenolphthalein should not give a red colour with a 0.5 per cent. solution.

Potassium cyanide. Test for chloride, sulphate, cyanate, thiocyanate, and ferrocyanide, and for sodium.

Potassium dichromate. Test for sulphate, chloride, calcium and aluminium.

Potassium ferrocyanide. Test for chloride, sulphate, and sodium.

Potassium hydroxide. Test for chloride, nitrate, nitrite, carbonate, sulphate, phosphate, silicate, sulphide, calcium and aluminium.

Potassium iodide. Test for carbonate (by alkalinity to litmus paper), chloride and bromide, iodate, nitrate, sulphate, sulphite and cyanide.

Potassium nitrate. Test for chloride, chlorate, perchlorate, sulphate, calcium, and sodium.

Potassium nitrite. Test for free alkali, carbonate, chloride, nitrate, sulphate, and lead.

Potassium permanganate. Test for chloride and sulphate after boiling a solution with alcohol, and for nitrate after decolorising with oxalic acid.

Sodium acetate. Test for common mineral acids.

Sodium carbonate. Test for chloride, sulphate, thiosulphate, phosphate, silicate, ammonia, iron, arsenic, calcium, and potassium.

Sodium chloride. Test for sulphate, iodide (by ferric chloride and starch), ammonia, calcium, magnesium, and potassium.

Sodium hydroxide. Test for chloride, nitrate, carbonate, sulphate, phosphate, borate, silicate, ammonia, aluminium, iron, calcium, and potassium.

Sodium nitrite. See *potassium nitrite,* also test for potassium by means of sodium cobaltinitrite

Sodium phosphate. Test for chloride, nitrate, carbonate, sulphate, arsenic, potassium, and calcium.

Sodium sulphate. Test for chloride, arsenic, and magnesium.

Sodium thiosulphate. Test for sulphate and sulphite, for free alkali with phenolphthalein, and for calcium.

Sulphuric acid. Test for halides, nitrate, ammonia, and arsenic.

Add a small amount of sodium sulphite to hydrochloric acid, and pour the mixture carefully on to an equal volume of the sulphuric acid; red ring indicates presence of selenium.

Mix with five times its volume of alcohol; turbidity indicates presence of lead.

The commercial acid frequently contains nitrous acid, sulphur dioxide, iron, and titanium.

Tartaric acid. Test for sulphate and calcium.

Table of the Limits of Lead and Arsenic

allowed in the Drugs of the British Pharmacopœia, 1914.

Strictly speaking, the British Pharmacopœia is not a legal standard, but it is a presumptive one for the articles and preparations named in it. Details for applying the tests for lead and arsenic are given in Appendices V and VI of the B.P. The last edition (1914) now uses the terms "purified alum" and "purified borax" to distinguish the medicinal from the commercial varieties. It also includes glucose, but in view of the "salts of tartar" litigation during 1914 the synonym "salts of tartar" for potassium carbonate has been omitted:

	Parts per Million. Pb.	As.
Acid, acetic (33% CH_3COOH)	–	2
„ acetylsalicylic	10	2
„ benzoic	–	2
„ boric	25	5
„ citric	20	1.4
„ hydriodic dilute (10% HI)	10	5
„ hydrobromic dilute (10% HBr)	5	5
„ hydrochloric (31.79% HCl)	10	5
„ lactic (75% lactone, 10% acid)	10	5
„ nitric (70% HNO_3 Sp. Gr. 1.42)	20	5
„ phosphoric conc. (Sp. Gr. 1.5) 66.3% H_3PO_4	10	5

	Parts per Million. Pb.	As.
Acid, salicylic	–	2
,, sulphuric (Sp. Gr. 1.841) 95% H_2SO_4	20	5
,, sulphurous (5% SO_2)	10	5
,, tartaric	20	1.4
Alum, purified (NH_4 or K)	0	5
Ammonia solution, strong (Sp. Gr. 0.888) ..	–	0.5
Ammonium benzoate	10	2
,, bromide	10	5
,, carbonate	5	2
,, chloride	5	5
Antimony, sulphuretted	–	1000
Bismuth carbonate	–	2
,, salicylate	–	2
,, subnitrate	–	2
Borax, purified	5	5
Calcium carbonate pptd.	10	5
,, chloride	20	5
,, hydroxide	20	5
,, hypophosphite	10	5
,, lactate	10	5
,, oxide	–	5
,, phosphate	–	5
Chalk, prepared	–	5
Copper sulphate	–	10
Ferric chloride solution, strong	–	10
,, sulphate solution	–	5
Ferrous sulphate	–	2
,, ,, exsiccated (77% $FeSO_4$)	–	5
,, carbonate, saccharated	–	5
Glucose	–	2
Glycerin	–	4
Iron (wire or nails)	–	200
,, reduced	–	200
,, ammonium citrate	–	5
,, potassium tartrate	–	5
,, and quinine citrate	–	5
Lithium carbonate	10	5
,, citrate	5	2
Magnesium bicarbonate solution	0.5	0.2
,, carbonate	20	5
,, oxide	20	5
,, sulphate	5	5
Potassium acetate	10	5
,, bicarbonate	5	5

	Parts per Million. Pb.	As.
Potassium bromide	10	5
,, carbonate	5	2
,, chlorate	10	5
,, citrate	10	2
,, iodide	10	5
,, nitrate	10	5
,, sulphate	20	5
,, tartrate	20	2
,, ,, acid	20	2
Sodium benzoate	10	2
,, bicarbonate	5	2
,, bromide	10	5
,, carbonate	10	2
,, ,, exsiccated (95% Na_2CO_3)	25	5
,, chloride	10	2
,, hypophosphite	10	5
,, iodide	10	5
,, nitrite	–	5
,, phosphate	5	5
,, ,, acid	5	2
,, potassium tartrate	20	2
,, salicylate	10	2
,, sulphate	5	2
,, sulphite	–	5
Strontium bromide	20	5
Sulphur, pptd.	–	5
,, sublimed	–	5
Zinc acetate	–	5
,, carbonate	–	10
,, chloride	–	5
,, oxide	–	10
,, sulphate	–	5
,, valerianate	–	5

VOLUMETRIC ANALYSIS.

Standard Solutions.

The term *normal* (N) is used to indicate a solution of which one litre contains the gram-equivalent of the dissolved substance. *Seminormal* (N/2), *decinormal* (N/10), *centinormal* (N/100), etc., solutions contain 1/2, 1/10, 1/100, etc., of the gram-equivalent per litre. For example, as hydrochloric acid is a monobasic acid, a normal solution contains 36·47 grm. per litre ($HCl = 36·47$), whereas a normal solution of sulphuric acid, a dibasic acid, contains 98·08/2 = 49·04 grm. per litre ($H_2SO_4 = 98·08$).

Similarly normal caustic soda contains 40·01 grm. per litre ($NaOH = 40·01$), whereas normal sodium carbonate contains 106·00/2 = 53·00 grm. per litre ($Na_2CO_3 = 106·00$).

Correction of Burette Readings to 15° C. (Schlösser).

°C.	Correction in cc. for 1 litre of N. HCl	N. H_2SO_4	N. HNO_3	N. $H_2C_2O_4$	N. NaOH	N. Na_2CO_3	N/10 solns.
5	+1.26	+1.94	+2.00	+1.33	+2.18	+2.03	+0.60
6	1.18	1.79	1.84	1.25	1.99	1.87	0.60
7	1.10	1.63	1.68	1.16	1.80	1.69	0.59
8	1.00	1.46	1.50	1.06	1.60	1.50	0.56
9	0.88	1.28	1.31	0.94	1.39	1.31	0.52
10	0.76	1.09	1.11	0.81	1.18	1.11	0.46
11	0.63	0.89	0.91	0.67	0.96	0.90	0.40
12	0.48	0.68	0.69	0.52	0.73	0.69	0.32
13	0.33	0.46	0.46	0.35	0.50	0.47	0.22
14	0.17	0.23	0.23	0.18	0.25	0.24	0.12
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	−0.18	−0.24	−0.25	−0.20	−0.25	−0.24	−0.13
17	0.36	0.49	0.50	0.40	0.51	0.49	0.27
18	0.56	0.75	0.76	0.61	0.78	0.75	0.42
19	0.76	1.02	1.03	0.82	1.05	1.02	0.59
20	0.97	1.30	1.30	1.05	1.33	1.29	0.76
21	1.19	1.58	1.58	1.29	1.62	1.57	0.95
22	1.41	1.86	1.87	1.54	1.92	1.85	1.14
23	1.64	2.15	2.17	1.80	2.23	2.14	1.35
24	1.88	2.45	2.47	2.07	2.54	2.44	1.56
25	2.14	2.76	2.78	2.31	2.85	2.75	1.79
26	2.40	3.08	3.10	2.62	3.17	3.06	2.02
27	2.67	3.41	3.43	2.90	3.50	3.38	2.27
28	2.95	3.75	3.76	3.19	3.83	3.70	2.52
29	3.23	4.09	4.10	3.49	4.17	4.04	2.78
30	3.52	4.43	4.44	3.82	4.52	4.38	3.06

STANDARD SOLUTIONS OF ACIDS, ALKALIES AND SALTS.

NOTE.—The formulæ given represent the commercial form of the salt; the figures, the number of grams of solid (including water of crystallisation, if definite) contained in a litre of the NORMAL *solution; and the* NORMALITY *of the solution for use in the laboratory is given in brackets.*

Acetic acid	60·04	(2N)
Ammonia	17·03	(2N)
Ammonium carbonate	(20% solution)	
Ammonium chloride, NH_4Cl	53·50	(2N)
Ammonium oxalate, $(NH_4)_2C_2O_4.H_2O$	71·06	(N/2)
Ammonium sulphate	66·07	(N)
Arsenious oxide, As_4O_6	49·48	
Barium chloride, $BaCl_2.2H_2O$	122·16	(N)
Calcium chloride, $CaCl_2 + x$ aq.	55·50	(N)
Caustic potash	56·11	(2N)
Caustic soda	40·01	(2N)
Cobalt nitrate, $Co(NO_3)_2.6H_2O$	145·54	(N)
Copper sulphate, $CuSO_4.5H_2O$	124·85	(N/2)
Ferric chloride, $FeCl_3 + x$ aq.	54·08	(N)
Hydrochloric acid	36·47	(2N)
Lead acetate, $Pb(C_2H_3O_2)_2.3H_2O$	189·66	(N)
Magnesium sulphate, $MgSO_4.7H_2O$	123·24	(N)
Mercuric chloride, $HgCl_2$	135·76	(N/2)
Mercurous nitrate, $Hg_2(NO_3)_2$	262·3	(N)
Nitric acid	63·02	(2N)
Oxalic acid, $H_2C_2O_4.2H_2O$	63·03	
Potassium dichromate, $K_2Cr_2O_7$	49·03	(N)
Potassium ferrocyanide, $K_4Fe(CN)_6.3H_2O$	105·62	(N)
Potassium iodide, KI	166·02	(N/2)
Potassium permanganate, $KMnO_4$	31·61	(N)
Potassium thiocyanate, KCNS	97·18	(N/2)
Silver nitrate, $AgNO_3$	169·9	(N/10)
Sodium carbonate, Na_2CO_3	53·00	(2N)
Sodium phosphate, $Na_2HPO_4.12H_2O$	119·4	(N/2)
Sodium thiosulphate, $Na_2S_2O_3.5H_2O$	124·10	(N/2)
Stannous chloride, $SnCl_2.2H_2O$	112·8	(N)
Sulphuric acid	49·04	(2N)
Zinc sulphate, $ZnSO_4.7H_2O$	143·8	(N/2)

Indicators

The number of indicators available for acidimetry and alkalimetry is so numerous—and the use of fresh compounds is constantly being suggested—that it is desirable to understand the principles on which the choice of a suitable indicator depends; it is not sufficient merely to be acquainted with statements of fact concerning the indicators more commonly used, such as "phenolphthalein must not be used, in presence of a carbonate, to determine total alkali," etc.

The function of an indicator is to give an indication of the concentration of hydrogen ions in a solution.

The indicators generally used are dyestuffs which are very weak or fairly weak acids, a few indicators being weak bases. In order that an electrolyte may act as an indicator, the non-ionised substance must differ in colour from that of its colour ion, and the value of the indicator will depend upon the amount of this difference in colour and the extent to which it ionises. The most suitable indicators are those which show one (and only one) very sharp change of colour for a small alteration in the concentration of the hydrogen ions, such as *p*-nitrophenol, phenolphthalein, Cyanine, etc.

Although other indicators, such as *lacmoid* (*resorcin blue*), which is decidedly acid in character, *litmus*, a weak acid, *methyl red*, and *Alizarin S*, are available, it will be sufficient to outline the theory of the action of *phenolphthalein* and of *methyl orange*.

Phenolphthalein is a very weak acid which is hence ionised only to an extremely small extent in the alcohol-water mixtures in which it is used. Representing phenolphthalein by PH, the ionisation may be represented as follows:

$$\mathrm{PH} \rightleftarrows \overset{+}{\mathrm{H}} + \overset{-}{\mathrm{P}}$$

The undissociated molecules are colourless, and the extent of dissociation into the intense red P-ions is so small that the solution is colourless. On adding a trace of a strong alkali, which will be almost completely dissociated, for example, as:

$$\mathrm{NaOH} \rightleftarrows \overset{+}{\mathrm{Na}} + \overset{-}{\mathrm{OH}}$$

the hydroxyl ions will combine with the hydrogen ions formed by the ionisation of the PH, and hence the

equilibrium of this ionisation will be disturbed, more hydrogen ions being formed and hence more P-ions, which will produce a red colour in the solution. On adding acid to the red solution, the concentration of the hydrogen ions is increased, the reverse process occurs, and the solution becomes colourless.

It will be obvious that the volume of a standard solution required for the change to the red colour depends upon the degree of ionisation of the alkali used, and hence phenolphthalein does not give a sufficiently sharp end-point with weak alkalies such as ammonium hydroxide, a solution of which contains comparatively few hydroxyl ions.

On the other hand, on account of the small concentration of hydrogen ions which causes the formation of non-ionised molecules of PH, phenolphthalein is the most delicate reagent available for the detection of traces of acids, the concentration of hydrogen ions in solutions of even weak acids such as carbonic acid (*e.g.*, in tap water), hydrogen sulphide, and organic acids, being sufficient to affect this indicator. Dichromates, silicates, aluminates, etc., may be titrated, using phenolphthalein as indicator. In the case of phosphoric acid, the solution becomes pink on titration with alkali before the stage Na_2HPO_4 has been attained, due to the hydrolysis of the disodium hydrogen phosphate :

$$Na_2HPO_4 + HOH \rightleftarrows NaH_2PO_4 + NaOH$$

and subsequent ionisation of the sodium hydroxide to form a sufficient concentration of hydroxyl ions to cause the formation of P-ions. The conversion into Na_2HPO_4 proceeds to completion on continuing the titration *until the maximum full red colour is attained*, a procedure which should be adopted in all titrations in which alkali is being added to a solution containing phenolphthalein. As such a small concentration of hydrogen ions is sufficient to decolorise the solution, titrations with acid should obviously proceed until the solution is quite colourless. Before titrating concentrated alkali solutions they must be diluted, as they destroy the red colour of the phenolphthalein; as the colour does not return on diluting, this must be due to a fundamental decomposition and not to ionic changes.

Methyl orange is commercial as the free acid and as the sodium and ammonium salts. The ionisation of the free acid may be represented as follows :

$$MH \rightleftarrows \overset{+}{H} + \overset{-}{M}$$

the concentration of hydrogen ions being considerable as it is a fairly strong acid. A concentrated solution of the free acid is red, which may be considered to be due to the molecules of non-ionised MH, but on dilution the solution passes through orange to yellow, the colour change being due to the formation of yellow M-ions. Addition of a trace of a strong acid to the yellow solution will increase the concentration of hydrogen ions, and hence form molecules of non-ionised MH. Addition of alkali to the red solution so obtained will lead to the combination of hydroxyl ions with hydrogen ions, and the consequent ionisation of the MH with production of further yellow M-ions.

Carbonic acid fails to affect methyl orange owing to the slight solubility of carbon dioxide in water, which does not permit of the formation of a concentration of hydrogen ions sufficient to cause the production of the non-ionised MH. Similar considerations apply to other weak acids, such as hydrocyanic, boric, arsenious, chromic, and organic acids and hydrogen sulphide. The alkali salts of many such acids may be titrated directly with acid using methyl orange as indicator.

It is to be noted that, on dilution with water or by heating, a red solution containing methyl orange and only a trace of acid, becomes yellow, due to an increase in the ionisation of the indicator. In titrating an alkali with an acid, the red colour will only appear when all the alkali has been neutralised and an *excess* of acid added, this excess depending on the *amount of indicator* used and the *dilution* of the solution. From theoretical considerations it would hence be more satisfactory to titrate with alkalies into acids if possible when using methyl orange as indicator, and always to use the smallest possible amount of an indicator, and the same amount in the same volume of liquid as that employed in the standardisation. On the other hand, the change from yellow to red is more easily detected in actual practice, particularly in decinormal solutions.

From these considerations it will be understood why methyl orange is more sensitive to alkalies than phenolphthalein, but not so sensitive to acids. Hence it may be used for the titration of sulphurous acid with caustic soda to form bisulphite, and of N/2 phosphoric acid to form the monosodium salt, the salt Na_2HPO_4 giving a sufficient concentration of hydroxyl ions by hydrolysis and subsequent ionisation to cause the change in colour.

The sodium salt commercial as methyl orange frequently contains carbonate and hence may not give such satisfactory

end-points as the free acid. The alteration in colour is interpreted in the same manner as described for the free acid, the amount of acid necessary to liberate the free acid being negligible.

On titrating a strong acid with a strong base, the solution is neutral when equivalent amounts of acid and alkali are present. This is not the case if ammonia is added in equivalent amount to hydrochloric acid, the solution being acid, due to the hydrolysis of the neutral salt; for a similar reason the addition of caustic soda in equivalent amount to boric acid gives an alkaline solution. In other words, the "equivalent-point" only corresponds to the "neutralisation point" in the case of strong acids and alkalies. Hence the use of an indicator which would show the *neutralisation* point of a weak acid with a strong base (litmus, alizarin, rosolic acid, etc.) would lead to low results being obtained, but would give too high results in the case of the titration of a strong acid with a weak base. It is therefore only possible to titrate weak electrolytes if the degree of hydrolysis of the "neutral" salt formed is taken into account.

The degree of hydrolysis of the salt solution can be calculated from the dissociation constant of the weak acid or base, or may be determined colorimetrically (see tables later).

As an example, the titration of aniline with hydrochloric acid may be mentioned. In case decinormal solutions are to be used, an indicator must be selected which gives a distinct change of colour with the hydrogen ions present in a decinormal solution of aniline hydrochloride. The degree of hydrolysis, x, is calculated from the following formula:

$$x = \sqrt{\frac{1}{c} \times \frac{K_w}{K_b}}$$

where K_b = dissociation constant of aniline
$= 4{\cdot}9 \times 10^{-10}$
$c = {}^1/_{10}$
$K_w = 1 \times 10^{-14}$

Therefore $x = 1{\cdot}4 \times 10^{-2}$
and $C_H = x \times c = 1{\cdot}4 \times 10^{-3}$
(this does not take into account the alteration of concentration during titration due to addition of the neutralising solution).

From the table it will be seen that the indicators which show a change of colour at a hydrogen ion concentration of 10^{-3} are: Methyl violet, Tropæoline 3O, dimethylamino-azobenzene, etc. The last-mentioned indicator has been used with success in the volumetric determination of aniline by titration with hydrochloric acid.

It has already been noted that phosphoric acid behaves as a monobasic acid on titration with alkali in case methyl orange is used as indicator, but dibasic when phenolphthalein is used as indicator. A decinormal solution of Na_2HPO_4 contains a hydrogen ion concentration of $1{\cdot}3\times10^{-9}$, whereas the hydrogen ion concentration in a decinormal solution of NaH_2PO_4 is $9{\cdot}3\times10^{-5}$. From the table it will be seen that the yellow colour of methyl orange commences at a hydrogen ion concentration of 1×10^{-5}, from which it follows that methyl orange gives an alkaline reaction with NaH_2PO_4; on the other hand, phenolphthalein becomes red at a hydrogen ion concentration of 1×10^{-9}, and therefore gives an acid reaction with Na_2HPO_4, a neutral reaction with NaH_2PO_4, and an alkaline reaction with Na_3PO_4. In the case of a decinormal solution of Na_3PO_4, the hydrogen ion concentration is $4{\cdot}3\times10^{-13}$; it follows that the indicators available for titrating phosphoric acid as a tribasic acid are: Alizarin blue, alizarin green, crocein, phenacetolin, and trinitrobenzene.

Dissociation Constants of Indicators. (Salm).

Indicator acids.

	$K = C_H$
Methyl orange	$4{\cdot}6 \times 10^{-4}$
p-Nitrophenol	$2{\cdot}3 \times 10^{-7}$
Rosolic acid	$1{\cdot}1 \times 10^{-8}$
Alizarin	$8{\cdot}8 \times 10^{-9}$
Phenolphthalein	$8{\cdot}0 \times 10^{-10}$

Indicator bases.

	$K = C_{OH}$
Cyanine	$4{\cdot}2 \times 10^{-6}$
Dimethylaminoazobenzene..	$1{\cdot}4 \times 10^{-11}$

COLOUR CHANGES OF INDICATORS (Salm.)

The concentration of hydrogen ions in pure water (in gram-ions per litre) is $0{\cdot}8\times10^{-7}$ at 18° C. and $1{\cdot}09\times10^{-7}$ at 26° C. (Kohlrausch).

‖ indicates very distinct colour change; ▌ indicates definite, but not so sharp, colour change.

	Conc^{n} H ions =	2 N.	N.	1.10^{-1}	1.10^{-2}	1.10^{-3}	1.10^{-4}	1.10^{-5}
1	*Acid Magenta*	L.	▌ L.R.					
2	*Alizarin*	G.Y.						
3	*Alizarin S.*	Y.G.						‖ Br.
4	*Alizarin blue S.*	Br.R.	Pale Y.	(Very	faint in	acid and	neutral	solns.)
5	*Alizarin green B.*	L.	‖ Flesh					
6	*Alkali green*	Dark G.	▌ G.				▌ Light G.	becomes
7	*Alkanet*	P.						
8	*Azolitmin*	P.						
9	*Benzopurpurine B.*	B.	‖ B. Viol.	▌ Viol.		▌ R. Viol.	‖ P.	‖ R.Y.
10	*Cochineal*	Y.						Br.P.
11	*Congo red*	B.					‖ Viol.	‖ Scarlet
12	*Crocein*	B.	‖ P.					
13	*Curcumein*	L.	‖ R.Or.	‖ Y.				
14	*Cyanin*	C.						
15	*Dimethylaminoazobenzene*	Rasp R.				‖ Flesh	‖ Gold Y.	

1.10^{-6}	1.10^{-7}	1.10^{-8}	1.10^{-9}	1.10^{-10}	1.10^{-11}	1.10^{-12}	1.10^{-13}	1.10^{-14}	5.10^{-15}	
				L.R.		Pale L.—C.	C.			1
Br.Y.	Pale L.	L.				Viol.		Viol. B.	B.	2
R.					L.	Viol.				3
	G.Y.	Pale G.		G.		Viol.	B.	B.G	G.	4
						Bt.Y.	Bt.—G.			5
lighter	to C.							C.		6
			R. Viol.	Viol.	B.					7
Viol. P.	Viol.	B. Viol.	B.							8
								P.		9
L.		(Satura	ted soln.,	two	drops)					10
										11
							R.V.	V.		12
(Saturated	soln.)							Br.R.	G.	13
	Trace B.	Viol. B.								14
			(Very	dilute	soln.)					15

COLOUR CHANGES OF INDICATORS (Salm.)—*Continued.*

	Conc^{n} H ions =	2 N.	N.	1.10^{-1}	1.10^{-2}	1.10^{-3}	1.10^{-4}	1.10^{-5}
16	*Eosine-Methylene blue*	G.	Light B.	B.		B. Viol.		
17	*Erythrosine*	G.Y.	P.		(Colour	gradually	deepens)	
18	*Fast red*	Y.R.	G.Br.	R.		(Colour	gradually	deepens)
19	*Fluorescein*	G.Y.						
20	*Gallein*	Or.			Y.	R.Y.	Or.R.	R.
21	*Guiacum tincture*	C.						
22	*Hæmatoin**	Rasp. R.	P.	G.Gr.	G.Y.—Gr.		G.Y.	
23	*Helianthine I.*	P.	Gr.					
24	*Helianthine II.*	P.	G.Y.					
25	*Lacmoid*	P.						Viol.
26	*Magdala red*	Y.	P.				R. Fluor.	
27	*Malachite green*	Y.Br.		G.	B.			
28	*Mauveine*	Y.	G.	G.B.	B.	Viol.		
29	*Methyl green*	Y.G.		G.	B.			
30	*Methyl orange*	P.R.				Or.R.	Or.	Y.

*The colorations are fugitive.

1.10^{-6}	1.10^{-7}	1.10^{-8}	1.10^{-9}	1.10^{-10}	1.10^{-11}	1.10^{-12}	1.10^{-13}	1.10^{-14}	5.10^{-15}	
								Viol.	L.R.	16
										17
										18
G.Fluor.										19
Viol. R.					‖ B.Viol–Br.	B. Viol.		‖ B.		20
		‖ Y.G.								21
‖ R.Br.	‖ Light L.	‖ Viol.	‖ R. Viol.	R. Viol. —R.Br.	‖ R. Viol. —Br.	‖ Dark R. Viol.	Dark R.—Br.	Dark B. Br.-Y G.	‖ B.Viol.	22
						‖ Or.R.	R.			23
						Br.Y.	‖ L.			24
Viol B.		B.	(Colour	changes	gradual,	not	sharp)			25
									‖ L.	26
						Light B.	B.—C.	‖ C.		27
			(Colour	fades	gradually)			‖ Viol. R.	‖ Y.R.	28
					Light B.	Trace B.	Trace B.—C.	C.		29
(Very	dilute	soln,	0·05%,	or colour-	change	indefinite)			‖ C.	30

COLOUR CHANGES OF INDICATORS (Salm.)—*Continued.*

	Conc^n H ions =	2 N.	N.	1.10^{-1}	1.10^{-2}	1.10^{-3}	1.10^{-4}	1.10^{-5}
31	*Methyl violet*	Gold Y.	G.	G.B.	B.	**Viol.**		
32	*α-Naphthol benzoin*	Br.Y.						
33	*Neutral red*	B.	B. Viol.	Rasp. R.				
34	*p-Nitrophenol*	C.						
35	*Phenacetolin*	Y.					Br.Y.	Br.R.
36	*Phenolphthalein*	C.		(Dilute	soln.	essential)		
37	*Rosolic acid*	Y.				Light Br.		
38	*Safranine*	B.	L.	P.R.				
39	*Tetrabromo-phenolphthalein*	C.						
40	*Thymolphthalein*	C.						
41	*Trinitrobenzene*	C.						
42	*Tropæoline*	R. Viol.	Flesh	Y.				
43	*Tropæoline O.*	Y.						G.Y.
44	*Tropæoline 20.*	R. Viol.		Rasp R.	Flesh	Y.		
45	*Tropæoline 30.*	P.	Gold Y.					

1.10^{-6}	1.10^{-7}	1.10^{-8}	1.10^{-9}	1.10^{-10}	1.10^{-11}	1.10^{-12}	1.10^{-13}	1.10^{-14}	5.10^{-15}	
							Viol. slowly—C.	Viol. quickly —C.	C.	31
				G.	G.B.					32
	P.R.	Or.	Y.							33
Light G.	G.Y.									34
P.R.					Viol. R.	Viol.	C.			35
			P.	R.				R.—C.	C.	36
	P.	R.						Light R.	R.—C.	37
									Viol.	38
			Viol.				Viol. slowly—C.	Viol. quickly —C.	C.	39
					B.				B.—C.	40
							Or.	R.Or.	Pract. C	41
		Flesh	P.R.							42
						Or.	R.Or.			43
									Pract. C.	44
						Or.	Or.R.			45

TABLE FOR SELECTION OF INDICATORS (Salm.)

	Conc^{n} H ions =	2 N.	N.	1.10^{-1}	1.10^{-2}	1.10^{-3}	1.10^{-4}	1.10^{-5}
28	*Mauvein*	Y.	G.	G.B.	B.	Viol.		
11	*Congo red*	B.				B.	Viol.	Scarlet
8	*Alizarin S.*	Y.G.						Br.
37	*Rosolic acid*	Y.				Light Br.		
36	*Phenolphthalein*	C.						
32	*α-Naphthol benzoin*	Br.Y.						
43	*Tropæoline O.*	Y.						G.Y.
41	*Trinitrobenzene*	C.						
9	*Benzopurpurine B.*	B.	B. Viol.	Viol.		R. Viol.	P.	R.Y.
38	*Safranine*	B.	L.	P.R.				

$1 . 10^{-6}$	$1 . 10^{-7}$	$1 . 10^{-8}$	$1 . 10^{-9}$	$1 . 10^{-10}$	$1 . 10^{-11}$	$1 . 10^{-12}$	$1 . 10^{-13}$	$1 . 10^{-14}$	$5 . 10^{-15}$	
								Viol R.	Y.R.	28
										11
R.					L.	Viol.				8
Light Br.	P.	R.						Light R.	R.—C.	37
		C.	P.	R.				R.—C.	C.	36
				G.	G.B.					32
					G.Y.	Or.	R.Or.			41
						C.	Or.	R.Or.	Pract. C.	48
							R.Y.	P.		9
								P.R.	Viol.	38

ABBREVIATIONS FOR COLOURS.

R. red; P. pink; B. blue; Y. yellow; G. green· Br. brown· Bl. black· Gr. Grey; Viol. violet; L. Lilac; Or. orange.

Neutralisation Methods.

Standards.

Numerous substances have been recommended for use as standards in acidimetry and alkalimetry on account of the purity of samples readily obtained.

Sodium carbonate, prepared by heating the bicarbonate (well washed with ice-cold water) at 180—200° C. until constant in weight, must be heated in the air-oven each time before use.

Organic acids (*e.g.* recrystallised oxalic acid) have been recommended. As phenolphthalein is used as indicator, the alkali solution employed must be free from carbonate. Such a solution is prepared by careful addition of baryta water to the caustic alkali solution.

Combined ammonia. The neutral solution is boiled with a measured excess of standard alkali and titrated back with standard acid, using methyl orange as indicator.

Estimation of nitrates as ammonia. 1 grm. of the commercial nitrate is dissolved in 250 cc. of water, 25 cc. withdrawn into the flask (preferably of copper) of an ammonia distillation apparatus, 100 cc. of dilute caustic soda and then exactly 20 cc. of titanous chloride or sulphate solution (20 per cent.) added. The solution is distilled for twenty minutes, and the ammonia produced collected in decinormal sulphuric acid; the excess is titrated with decinormal alkali. The distillation is repeated in absence of nitrate, using the same volume of titanous chloride solution, in order to ascertain the amount of ammonia due to nitrogen compounds in this reagent. (It is now stated that it is unnecessary to carry out a "blank" on the titanous chloride.)

Estimation of total alkali in water-glass. 1–2 grm. of water-glass are weighed out, dissolved in 50 cc. of hot water in a porcelain dish, the solution diluted to 200 cc., and titrated with normal sulphuric acid, using methyl orange as indicator.

Valuation of borax. (*a*) *Total alkali* is estimated by titration with normal sulphuric acid, using methyl orange as indicator, when all the boric acid is liberated.

(*b*) After heating the neutralised solution from (*a*) *almost* to the boiling-point, to free from carbon dioxide, it is mixed with an equal bulk of neutral glycerin solution (prepared by mixing glycerin with an equal volume of water, adding

phenolphthalein, and titrating with caustic soda). The mixture is then titrated with normal caustic soda, the phenolphthalein acting as indicator. The B_2O_3 is converted into metaborate ($NaBO_2$).

Valuation of argol. 2 grm. are weighed accurately into a porcelain crucible. The total amount of tartrate present is determined by igniting over a small Bunsen flame, to convert into carbonate. The residue is extracted with water, the liquid filtered, and the potassium carbonate in the solution titrated with standard acid.

The percentage of bitartrate ($KHC_4H_4O_6$) present is ascertained by dissolving 2–3 grm. in hot water and titrating with caustic soda, using phenolphthalein as indicator. From this the amount of potassium carbonate formed in the above ignition due to bitartrate may be calculated, and then the amount due to neutral tartrate ($K_2C_4H_4O_6$), from which the percentage of neutral tartrate may be obtained.

Oxidation Methods.

(1) Potassium Permanganate and Potassium Dichromate.

In presence of oxidisable material, an acid solution of potassium permanganate contains available oxygen according to the following equation:

$$2KMnO_4 + 4H_2SO_4 = 2KHSO_4 + 2MnSO_4 + 3H_2O + 5O.$$

That is, $2KMnO_4$ are equivalent to 5O. Hence a decinormal solution of potassium permanganate, 1 litre of which is to be equivalent to 8 grm. of oxygen, must contain (for use in acid solution)

$$\frac{2(158)}{2 \times 5 \times 10} = 3{\cdot}16 \text{ grm. } KMnO_4 \text{ per litre.}$$

In case the permanganate is used in neutral or alkaline solution, a decinormal solution will contain

$$\frac{2(158)}{2 \times 3 \times 10} = 5{\cdot}267 \text{ grm. } KMnO_4 \text{ per litre,}$$

based on the equation:

$$2KMnO_4 + H_2O = 2MnO_2 + 2KOH + 3O.$$

In the titration of oxalic acid (in presence of sulphuric acid and at 60–70° C.), the reaction which occurs may be represented as follows:

$$(COOH)_2 + O = 2CO_2 + H_2O.$$

In the estimation of hydrogen peroxide (in sulphuric acid solution), the reaction may be represented as follows:

$$H_2O_2 + O = H_2O + O_2.$$

In the estimation of ferrocyanides (in presence of a large amount of sulphuric acid), the reaction involved is the oxidation of $H_4Fe(CN)_6$ to $H_3Fe(CN)_6$.

In the estimation of nitrite, it is preferable to titrate with the nitrate solution into the warm diluted permanganate, the reaction being:

$$HNO_2 + O = HNO_3.$$

Similar reasoning to the above applies to a decinormal solution of potassium dichromate (used in presence of hydrochloric acid), a decinormal solution of which contains

$$\frac{294 \cdot 2}{2 \times 3 \times 10} = 4 \cdot 903 \text{ grm. } K_2Cr_2O_7 \text{ per litre,}$$

based on the equation:

$$K_2Cr_2O_7 + 5H_2SO_4 = 2KHSO_4 + Cr_2(SO_4)_3 + 4H_2O + 3O.$$

Standards.

Recrystallised ammonium oxalate or very carefully purified oxalic acid may be used in standardising potassium permanganate (in sulphuric acid solution at 60–70°C.).

Ferrous ammonium sulphate is available for standardising potassium permanganate (in sulphuric* acid solution) or potassium dichromate (in hydrochloric acid solution), but must be carefully prepared, as the iron content of commercially pure samples frequently differs from the theoretical value. The indicator used in titrations with potassium dichromate is a dilute solution of potassium ferricyanide (freshly prepared from washed crystals), employed as an outside indicator on a spot plate to show when the conversion of $Fe^{\cdot\cdot}$ to $Fe^{\cdot\cdot\cdot}$ is complete.

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*It has been stated that the presence of manganese sulphate prevents the interaction of hydrochloric and permanganic acids; it is, however, inadvisable to titrate with permanganate in presence of hydrochloric acid, dichromate being available in such a case. For example, in the estimation of a ferric salt, the ferric salt may be reduced (*a*) with zinc and sulphuric acid, the ferrous salt being titrated with permanganate; or (*b*) with zinc and hydrochloric acid which is much quicker, or even more rapidly with stannous chloride solution (the excess of which is oxidised by careful addition of mercuric chloride solution), in which case the ferrous salt is titrated with dichromate.

(2) Iodimetry.

The following equation represents the reaction between iodine and sodium thiosulphate, resulting in the formation of sodium tetrathionate:

$$2Na_2S_2O_3 + I_2 = Na_2S_4O_6 + 2NaI.$$

Sodium thiosulphate solution should be preserved in full, stoppered bottles, out of contact with air containing carbon dioxide, which causes precipitation of sulphur.

Standards.

Sodium thiosulphate solution may be standardised against decinormal permanganate as follows: 25 cc. of standard permanganate are acidified with 10 cc. of dilute sulphuric acid, 10 cc. of a 10 per cent. solution of potassium iodide added, and the iodine liberated titrated with thiosulphate solution until of a pale yellow tint, and then either (i) a few cc. of a freshly prepared starch solution added and the liquid titrated until the violet colour finally disappears, or (ii) 1 cc. of a 0.5 per cent. solution of methylene blue added and the liquid titrated until the brown colour has changed through green to blue.

In case the thiosulphate is to be used for the determination of copper, it is preferable to standardise in the following manner: 0.3 grm. of electrolytic copper are dissolved in 10 cc. of nitric acid (1 : 1) in a conical flask, inclined in order to prevent spurting, the solution diluted with 20 cc. of water and boiled for a few moments to expel nitric fumes. The solution is rinsed into a beaker, sodium carbonate added until the liquid is opalescent, and then a slight excess of acetic acid added. 10 cc. of a 10 per cent. solution of potassium iodide are added and the iodine liberated titrated with thiosulphate solution until the precipitate is almost white; starch solution is then added and the liquid titrated until it remains colourless on standing for one minute.

Standard iodine solution is prepared by dissolving 13 grm. of iodine in a litre of water containing 30 grm. of potassium iodide, and is standardised against decinormal thiosulphate.

Valuation of bleaching powder. 10–12 grm. of sample of bleaching powder are ground to a paste with water in a porcelain mortar, and more water added. After allowing to settle, the turbid liquid is decanted into a litre flask. The residue is ground with further amounts of water until the whole of the solid has been transferred to the flask. The liquid is made up to a litre, 25 cc. of the turbid liquid withdrawn by pipette, 10 cc. of a 10 per cent. solution of potassium iodide added, the solution acidified with acetic acid, and titrated with decinormal thiosulphate.

An alternative method is to use a standard solution of arsenious oxide, prepared by dissolving 4.95 grm. of arsenious oxide in caustic soda, acidifying with hydrochloric acid, and adding an excess of sodium bicarbonate. The reaction used is as follows:

$$As_2O_3 + 2I_2 + 4NaHCO_3 = As_2O_5 + 4NaI + 4CO_2 + 2H_2O.$$

A measured excess of arsenious oxide is added to the bleaching powder solution prepared as above, and the excess titrated with decinormal iodine.

Estimation of chlorate. Owing to the possible presence of free chlorine in hydrochloric acid and of iodate in the potassium iodide, a "blank" must be carried out in this estimation. 10 grm. of potassium iodide (weighed to the nearest decigram) dissolved in about 50 cc. of water, and 20 cc. of concentrated hydrochloric acid, are placed in each of two 250 cc. bottles with well-fitting glass stoppers. About 0.5 grm. of commercial chlorate is dissolved in water, and added to the contents of one bottle. The stoppers are fastened to the necks of the bottles. The bottles are immersed in a steam bath for twenty minutes, removed and allowed to cool. The contents of the bottle to which chlorate has been added are made up to 250 cc. in a measuring flask, and 25 cc. titrated with decinormal thiosulphate, using starch or methylene blue as indicator. The contents of the other bottle are titrated direct, and the suitable correction subtracted from the previous titration.

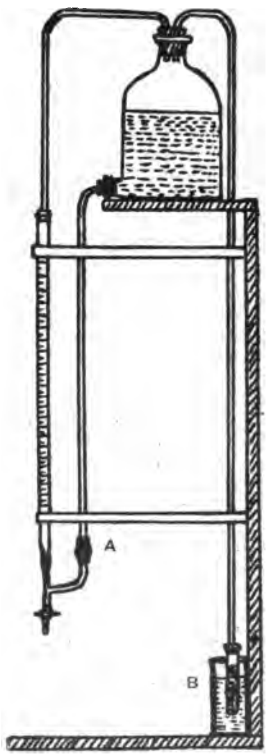
Determination of sulphite. 5 grm. of commercial sulphite are dissolved in 250 cc. of water. 25 cc. are withdrawn, a measured excess of decinormal iodine added, and the excess titrated with decinormal thiosulphate.

(3) Titanous Chloride and Methylene Blue.

For many purposes the use of standard solutions (N/50 to N/40) of these two reagents has decided advantages over the methods at present more frequently adopted. Examples are the estimation of iron as ferric salt, chromium as chromate, stannous chloride, and of other substances which act as, or may be quantitatively converted into, oxidising or reducing agents. *It is to be remembered that, whereas titanium is frequently classed amongst the "rarer" metals, it is actually estimated to be present in the earth's crust to the extent of over 1 per cent.*, that is, *to a greater extent than carbon.* It is therefore not surprising that titanium reagents are comparatively cheap. To emphasise this it may be remarked that the material necessary for the preparation of one litre of decinormal titanous chloride (the

standard solution actually used is nearer to N/50) would cost threepence, whereas that for a litre of decinormal iodine, which reagent it frequently replaces, would cost about two shillings (including the cost of the potassium iodide necessary for the solution of the iodine).

The standard solution of methylene blue is quite stable, but the preservation of standard titanous chloride necessitates the use of a special storage apparatus. The storage vessel is filled with a thoroughly mixed solution containing 25 cc. of 20 per cent. titanous chloride solution and 50 cc. of concentrated hydrochloric acid per litre. By opening the burette tap, a current of hydrogen from the generator, B, may be passed through the apparatus for five minutes. The contents of the storage vessel are again mixed, and the burette filled by opening the bead valve at A. After running off several cc., the apparatus is ready for use.



A standard solution of methylene blue is prepared by dissolving 4–5 grm. of the hydrochloride (free from zinc) in 500 cc. of hot water, and diluting to a litre. A standard solution of pure potassium chlorate is also prepared by dissolving 0.6–0.7 grm. in a litre of cold, recently boiled water.

Standardisation of solutions. (1) 50 cc. of the methylene blue solution are withdrawn into an 8 oz. conical flask, an equal volume of dilute hydrochloric acid added, and a current of carbon dioxide passed into the flask. The liquid is heated to boiling, and titrated whilst warm with the titanous chloride solution until the blue colour disappears. The current of carbon dioxide is maintained,

and 25 cc. of the potassium chlorate solution added to the contents of the flask, the solution warmed to about 40° C. if necessary (to obtain a sharp end-point), and the warm solution titrated with titanous chloride. The second titration gives the volume of titanous chloride equivalent to the oxygen available in 25 cc. of the standard potassium chlorate solution (due to its reduction to chloride by the reduced methylene blue), and hence the oxygen equivalent and iron equivalent of 1 cc. of titanous chloride may be calculated. The volume of titanous chloride equivalent to 50 cc. of methylene blue is known from the first titration, and from this the oxygen equivalent and iron equivalent of 1 cc. of methylene blue may be calculated.

(2) In case pure ferrous ammonium sulphate is available, and an iron estimation is to be carried out by means of titanous chloride, the following method may be used for standardising the titanous chloride solution :* 3–4 grm. of ferrous ammonium sulphate are dissolved in 100 cc. of water, an equal volume of dilute sulphuric acid added, and the solution made up to 250 cc. in a measuring flask. 25 cc. are oxidised with dilute potassium permanganate, an excess of which may be destroyed by adding hydrochloric acid and boiling for several minutes. A current of carbon dioxide is passed into the flask, 20 cc. of potassium thiocyanate solution added, and the solution titrated with titanous chloride solution until colourless.

Another method is to add 2 drops of methylene blue solution to the ferric salt solution, warm to about 40° C. and titrate with titanous chloride solution until decolorised. As the methylene blue requires 2 drops of titanous chloride for its decoloration, 0.1 cc. must be subtracted from the titration.

In case method (2) is used, as the titanous chloride solution oxidises slowly even in the special storage apparatus, it is convenient to keep a standard solution of iron alum, containing about 14 grm. per litre and acidified with sulphuric acid, for re-standardising purposes; this solution remains the same strength for an indefinite period, and may be standardised by titration with titanous chloride immediately after this reagent has been standardised as above. This is not necessary if the titanous chloride is to be used in conjunction with standard methylene blue, as the

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* See Knecht and Hibbert, *New Reduction Methods in Volumetric Analysis*.

titration of the latter solution, which keeps its standard indefinitely, will serve as standardisation.

Determination of Ferric salt. 25 cc. of the ferric salt solution is diluted to 100 cc. with water, boiled for a few moments, allowed to cool to about 40°C. in an atmosphere of carbon dioxide, two drops of methylene blue added, and titrated as in method of standardisation (2) above. The titanous chloride is standardised against standard iron alum solution.

Another convenient method is as follows: 25 cc. of standard methylene blue are reduced with titanous chloride as in method of standardisation (1), by which means the reagent is standardised; 25 cc. of the ferric salt solution are added, and the methylene blue produced by the reduction of the ferric salt titrated with titanous chloride.

Estimation of Chlorate. The procedure will be clear from a consideration of method of standardisation (1) above. The process is unaffected by the presence of perchlorates, which do not oxidise reduced methylene blue under these conditions.

Estimation of Chromium or Chromate. 50 cc. of the solution containing a suitable amount of chromium are taken, a slight excess of caustic soda added, and then small amounts of sodium peroxide are added until the oxidation and solution of the chromium hydroxide is complete. After boiling for ten minutes to destroy the excess of sodium peroxide, the solution is diluted to 250 cc. 25 cc. of this solution are added to reduced methylene blue solution (the chromate is reduced to a chromic salt), and the methylene blue produced is titrated.

Estimation of Stannous Chloride. 1 grm. of commercial sample is dissolved in 50 cc. dilute hydrochloric acid, and made up to 250 cc. with cold, recently boiled water. 25 cc. are withdrawn into a conical flask through which a current of carbon dioxide is maintained, an equal volume of concentrated hydrochloric acid added, and the solution titrated with standard methylene blue* until the blue colour persists. (In case the concentrated hydrochloric acid contains free chlorine, as is frequently the case, the necessary correction for its action in oxidising some stannous chloride is readily made by repeating the titration, using double the volume

* A method of standardising methylene blue which does not necessitate the use of titanous chloride has been described (Atack, *J. Soc. Dyers and Col.*, 1913, p. 9).

(50 cc.) of hydrochloric acid, when any decrease in the volume of methylene blue used is to be added to the first titration.)

Valuation of Hydrosulphite. 50 cc. of standard methylene blue are measured into a conical flask through which a current of carbon dioxide is maintained, 0.1 to 0.2 grm. of sodium hydrosulphite introduced from a weighing bottle, 10 cc. of acetic acid added, the liquid warmed, and the excess of methylene blue determined by means of titanous chloride (previously standardised against 25 cc. of the standard methylene blue). The percentage of $Na_2S_2O_4$ in the sample is calculated on the basis that one molecule requires one atom of oxygen for its oxidation.

Precipitation Methods.

(1) Silver Nitrate and Ammonium Thiocyanate.

Standard silver nitrate solution may be standardised against pure, fused sodium chloride.

In estimating halides or cyanide (in *neutral* solution) by means of decinormal silver nitrate, several drops of (neutral) potassium chromate solution are added, and the titration continued until the precipitate becomes reddish. Cyanides may be titrated direct with silver nitrate, the soluble double cyanide being formed until half the cyanide present has been converted into silver cyanide; further addition of silver nitrate gives an opalescence which marks the end-point, due to the precipitation of silver cyanide.

Standard thiocyanate solution may be standardised against decinormal silver nitrate or against pure silver foil dissolved in nitric acid (1 : 1). Ammonium thiocyanate solution is added to the *acid* solution of the silver salt containing ferric sulphate until, after allowing to settle, the clear liquid above the white ppt. has acquired a permanent blood-red colour. A suitable solution of ferric sulphate is prepared by oxidising 100 cc. of a saturated solution of ferrous sulphate with 50 cc. of concentrated nitric acid, boiling to expel nitric fumes (nitrous acid must be absent). The presence of free nitric acid is essential, as lead, copper and zinc do not then affect the titration; mercury must be absent, and large amounts of copper mask the end-point.

(2) Potassium Ferrocyanide.

It is convenient to prepare a solution of which 1 cc. corresponds approximately to 0.01 grm. of zinc by dissolving 45 grm. of the pure salt in a litre of water. This solution is

standardised as follows: 2.5 grm. of pure zinc are dissolved in 25 cc. of hydrochloric acid (1 : 1) and the solution diluted to 250 cc. 25 cc. of this standard zinc solution is withdrawn, diluted to 200 cc., 5 grm. of ammonium chloride and 10 cc. of concentrated hydrochloric acid added, and the solution heated to 80°C. Ferrocyanide solution is added until a drop of the liquid gives a brown coloration with a saturated solution of uranium acetate on a spot plate. The precipitation of the zinc ferrocyanide does not take place immediately; hence the solution must be allowed to stand for one minute, the spot test repeated, and further ferrocyanide solution added if necessary.

(3) Sodium Sulphide.

5–6 grm. of caustic soda are dissolved in 200 cc. of water; 100 cc. of the solution are saturated with hydrogen sulphide, the other half added, the mixture filtered and diluted to a litre. This solution is standardised by adding to a decinormal zinc sulphate solution, containing an excess of ammonia, until the indicator paper becomes black. The indicator papers are made by inserting one-half of a strip of filter-paper in an alcoholic solution of cobalt chloride and Aniline blue. The white portion of the paper is placed in the zinc solution which is being titrated, and the blue portion becomes black when excess of sodium sulphide has been added.

Copper, nickel, and cobalt may also be determined in this manner.

FACTORS FOR QUANTITATIVE ANALYSIS.

Calculated from International Atomic Weights, 1917.

Weighed as.	Required.	Factor.	Log.
Aluminium.			
Al_2O_3	Al	0.53034	$\bar{1}.72455$
	$AlCl_3$	2.61226	0.41700
$AlPO_4$	Al_2O_3	0.41837	$\bar{1}.62156$
Ammonium.			
NH_4Cl	NH_3	0.31836	$\bar{1}.50292$
	NH_4	0.33702	$\bar{1}.52766$
	NH_4OH	0.65489	$\bar{1}.81617$
$(NH_4)_2PtCl_6$	NH_3	0.07673	$\bar{2}.88494$
	NH_4	0.08123	$\bar{2}.90968$
	N	0.06311	$\bar{2}.80007$
	NH_4Cl	0.24095	$\bar{1}.38193$
Pt	NH_3	0.17452	$\bar{1}.24186$
	NH_4	0.18475	$\bar{1}.26660$
	N	0.14355	$\bar{1}.15699$
	NH_4Cl	0.54809	$\bar{1}.73886$
$(NH_4)_2SO_4$	NH_3	0.25781	$\bar{1}.41130$
Antimony.			
Sb_2O_3	Sb	0.83354	$\bar{1}.92093$
	Sb_2S_3	1.16705	0.06709
	SbO_2	1.16643	0.06686
Sb_2O_4	Sb	0.78975	$\bar{1}.89749$
	Sb_2O_3	0.94746	$\bar{1}.97656$
	Sb_2O_5	1.05255	0.02225
Sb_2O_5	Sb	0.75031	$\bar{1}.87524$
	Sb_2S_3	1.05050	0.02140
	Sb_2O_3	0.90015	$\bar{1}.95431$
Sb_2S_3	Sb	0.71424	$\bar{1}.85384$
	Sb_2O_3	0.85686	$\bar{1}.93291$
	Sb_2O_5	0.95192	$\bar{1}.97860$
$NaH_2Sb_2O_7$	SbO_2	0.84365	$\bar{1}.92617$
	Sb_2O_3	0.72026	$\bar{1}.85749$
	Sb_2O_5	0.80017	$\bar{1}.90318$

Factors for Quantitative Analysis—*(continued)*.

Weighed as.	Required.	Factor.	Log.
Arsenic.			
As_2S_3	As	0.60918	$\bar{1}.78476$
	As_2O_3	0.80423	$\bar{1}.90538$
	As_2O_5	0.93426	$\bar{1}.97047$
	AsO_4	1.12930	0.05281
As_2O_3	As	0.75746	$\bar{1}.87937$
	AsO_3	1.24243	0.09431
	As_2O_5	1.16170	0.06509
	AsO_4	1.40420	0.14743
As_2O_5	As	0.65204	$\bar{1}.81428$
	As_2O_3	0.86082	$\bar{1}.93491$
	AsO_3	1.06960	0.02922
	AsO_4	1.20875	0.08234
$Mg_2As_2O_7$	As_2O_3	0.63731	$\bar{1}.80435$
	As_2O_5	0.74035	$\bar{1}.86944$
	AsO_4	0.89492	$\bar{1}.95178$
	As_2S_3	0.79246	$\bar{1}.89897$
	As_2S_5	0.99869	$\bar{1}.99943$
	AsO_3	0.79187	$\bar{1}.89866$
Barium.			
$BaSO_4$	Ba	0.58848	$\bar{1}.76973$
	BaO	0.65701	$\bar{1}.81758$
	$BaCl_2$	0.89230	$\bar{1}.95051$
$BaCO_3$	Ba	0.69598	$\bar{1}.84260$
	BaO	0.77706	$\bar{1}.89045$
	$BaCl_2$	1.05533	0.02338
BaO	Ba	0.89568	$\bar{1}.95215$
$BaCrO_4$	Ba	0.54216	$\bar{1}.73413$
	BaO	0.60531	$\bar{1}.78198$
	$BaCl_2$	0.82207	$\bar{1}.91491$
$BaSiF_6$	Ba	0.49118	$\bar{1}.69124$
	BaO	0.54839	$\bar{1}.73909$
$BaCl_2$	Ba	0.65951	$\bar{1}.81922$
	BaO	0.73633	$\bar{1}.86707$
Bismuth.			
Bi_2O_3	Bi	0.89654	$\bar{1}.95257$
Bi_2S_3	Bi	0.81221	$\bar{1}.90967$
	Bi_2O_3	0.90594	$\bar{1}.95710$
Boron.			
B_2O_3	B	0.31429	$\bar{1}.49733$
Bromine.			
$AgBr$	Br	0.42556	$\bar{1}.62896$
	HBr	0.43092	$\bar{1}.63440$

Factors for Quantitative Analysis—(*continued*).

Weighed as.	Required.	Factor.	Log.
Cadmium.			
CdO	Cd	0.87540	$\bar{1}$.94221
	CdS	1.12510	0.05119
CdS	Cd	0.77807	$\bar{1}$.89102
	CdO	0.88882	$\bar{1}$.94881
Calcium.			
CaO	Ca	0.71465	$\bar{1}$.85409
	$CaCl_2$	1.97945	0.29655
$CaSO_4$	Ca	0.29435	$\bar{1}$.46886
	CaO	0.41188	$\bar{1}$.61477
	$CaCl_2$	0.81530	$\bar{1}$.91132
$CaCO_3$	Ca	0.40041	$\bar{1}$.60250
	CaO	0.56029	$\bar{1}$.74841
	$CaCl_2$	1.10907	0.04496
CO_2	$CaCO_3$	2.27415	0.35682
Carbon.			
CO_2	C	0.27280	$\bar{1}$.43586
	CO_3	1.36360	0.13469
$CaCO_3$	CO_2	0.43972	$\bar{1}$.64318
	CO_3	0.59962	$\bar{1}$.77787
$BaCO_3$	CO_2	0.22295	$\bar{1}$.34821
	CO_3	0.30402	$\bar{1}$.48290
Chlorine.			
$AgCl$	Cl	0.24738	$\bar{1}$.39337
	HCl	0.25442	$\bar{1}$.40556
	ClO_3	0.58225	$\bar{1}$.76511
	ClO_4	0.69388	$\bar{1}$.84128
	$NaCl$	0.40784	$\bar{1}$.61049
	KCl	0.52016	$\bar{1}$.71614
	$NaClO_3$	0.74270	$\bar{1}$.87081
	$KClO_3$	0.85502	$\bar{1}$.93198

Factors for Quantitative Analysis—*(continued).*

Weighed as.	Required	Factor.	Log.
Chromium.			
Cr_2O_3	Cr	0.68422	$\bar{1}$.83519
	CrO_3	1.31580	0.11919
	CrO_4	1.52635	0.18366
	Cr_2O_7	1.42106	0.15261
$BaCrO_4$	Cr	0.20523	$\bar{1}$.31224
	CrO_3	0.39467	$\bar{1}$.59624
	CrO_4	0.45782	$\bar{1}$.66070
	Cr_2O_3	0.29996	$\bar{1}$.47706
	Cr_2O_7	0.42626	$\bar{1}$.62967
$PbCrO_4$	Cr	0.16079	$\bar{1}$.20653
	CrO_3	0.30941	$\bar{1}$.49053
	CrO_4	0.35892	$\bar{1}$.55499
	Cr_2O_3	0.23515	$\bar{1}$.37134
	Cr_2O_7	0.33416	$\bar{1}$.52395
$K_2Cr_2O_7$	Cr	0.35350	$\bar{1}$.54839
	Cr_2O_3	0.51666	$\bar{1}$.71320
	CrO_3	0.67981	$\bar{1}$.83239
	CrO_4	0.78859	$\bar{1}$.89685
	Cr_2O_7	0.73420	$\bar{1}$.86581
Cobalt.			
Co	CoO	1.27131	0.10426
CoO	Co	0.78658	$\bar{1}$.89574
$CoSO_4$	Co	0.38038	$\bar{1}$.58022
	CoO	0.48359	$\bar{1}$.68448
$K_3Co(NO_2)_6$	Co	0.13037	$\bar{1}$.11517
	CoO	0.16574	$\bar{1}$.21943
Copper.			
CuO	Cu	0.79892	$\bar{1}$.90250
Cu_2S	Cu	0.79864	$\bar{1}$.90236
	CuO	0.99963	$\bar{1}$.99984
	Cu_2O	0.89913	$\bar{1}$.95382
Cyanogen.			
Ag	CN	0.24115	$\bar{1}$.38228
AgCN	CN	0.19429	$\bar{1}$.28845
	HCN	0.20173	$\bar{1}$.30497
Fluorine.			
CaF_2	F	0.48675	$\bar{1}$.68730
	HF	0.51258	$\bar{1}$.70976
$BaSiF_6$	F	0.40762	$\bar{1}$.61026
	HF	0.42924	$\bar{1}$.63270
	H_2SiF_6	0.51602	$\bar{1}$.71267
	KF	0.41513	$\bar{1}$.61818

Factors for Quantitative Analysis—*(continued)*.

Weighed as.	Required.	Factor.	Log.
Gold.			
Au	$AuCl_3$	1.53943	0.18736
	Au_2O_3	1.12170	0.04988
Hydrogen.			
H_2O	H	0.11192	$\bar{1}.04884$
Iodine.			
I_2O_5	I	0.76037	$\bar{1}.88102$
	HI	0.76638	$\bar{1}.88445$
AgI	I	0.54054	$\bar{1}.73283$
	HI	0.54482	$\bar{1}.73626$
PdI_2	I	0.70402	$\bar{1}.84760$
	HI	0.70964	$\bar{1}.85103$
Iron.			
Fe_2O_3	Fe	0.69939	$\bar{1}.84472$
Lead.			
PbO	Pb	0.92833	$\bar{1}.96770$
PbO_2	Pb	0.86622	$\bar{1}.93763$
PbS	Pb	0.86580	$\bar{1}.93742$
	PbO	0.93265	$\bar{1}.96972$
	$PbSO_4$	1.26720	0.10285
$PbCl_2$	Pb	0.74500	$\bar{1}.87216$
$PbSO_4$	Pb	0.68323	$\bar{1}.83457$
	PbO	0.73599	$\bar{1}.86687$
	PbS	0.78914	$\bar{1}.89715$
Lithium.			
Li_2CO_3	Li	0.18786	$\bar{1}.27383$
Li_3PO_4	Li	0.17970	$\bar{1}.25454$
	LiCl	1.09785	0.04055
	Li_2O	0.38684	$\bar{1}.58753$
Magnesium.			
MgO	Mg	0.60317	$\bar{1}.78044$
$Mg_2P_2O_7$	Mg	0.21839	$\bar{1}.33923$
	MgO	0.36207	$\bar{1}.55879$
$MgSO_4$	Mg	0.20203	$\bar{1}.30540$
	MgO	0.33493	$\bar{1}.52496$
Manganese.			
MnO	Mn	0.77442	$\bar{1}.88898$
Mn_3O_4	Mn	0.72027	$\bar{1}.85749$
	MnO	0.93026	$\bar{1}.96851$
	MnO_4	1.55933	0.19297
MnS	Mn	0.63145	$\bar{1}.80033$
	MnO	0.81538	$\bar{1}.91136$
	MnO_4	1.36717	0.13582
$MnSO_4$	Mn	0.36380	$\bar{1}.56086$
	MnO	0.46977	$\bar{1}.67188$

Factors for Quantitative Analysis—*(continued)*.

Weighed as.	Required.	Factor.	Log.
Mercury.			
Hg	HgO	1.07977	0.03333
	HgS	1.15983	0.06439
	Hg_2O	1.03980	0.01696
	Hg_2Cl_2	1.17667	0.07069
HgO	Hg	0.92613	$\bar{1}.96667$
	HgS	1.07415	0.03106
HgS	Hg	0.86220	$\bar{1}.93561$
Hg_2Cl_2	Hg	0.84977	$\bar{1}.92931$
	HgO	0.91757	$\bar{1}.96264$
Molybdenum.			
MoS_3	Mo	0.49952	$\bar{1}.69856$
	MoO_2	0.66605	$\bar{1}.82360$
MoO_2	Mo	0.75000	$\bar{1}.87506$
Nickel.			
NiO	Ni	0.78575	$\bar{1}.89529$
$NiSO_4$	Ni	0.37922	$\bar{1}.57889$
	NiO	0.48261	$\bar{1}.68360$
$(C_4H_7O_2N_2)_2Ni$ (Dimethylglyoxime ppt.)	Ni	0.20311	$\bar{1}.30777$
$(C_{14}H_{11}O_2N_2)_2Ni$ (α-Benzildioxime ppt.)	Ni	0.10927	$\bar{1}.03848$
Nitrogen. (See also *Ammonium.*)			
$(NH_4)_2PtCl_6$	N	0.06310	$\bar{1}.80005$
	NO_3	0.27930	$\bar{1}.44607$
Pt	N	0.14355	$\bar{1}.15699$
	NO_3	0.63535	$\bar{1}.80301$
Palladium.			
PdI_2	Pd	0.29594	$\bar{1}.47120$
Phosphorus.			
P_2O_5	P	0.43694	$\bar{1}.64042$
	PO_4	1.33783	0.12640
$Mg_2P_2O_7$	P	0.27873	$\bar{1}.44519$
	PO_4	0.85343	$\bar{1}.93117$
	P_2O_5	0.63793	$\bar{1}.80477$
	P_2O_7	0.78161	$\bar{1}.89299$
	PO_3	0.70978	$\bar{1}.85112$
Phosphomolybdate ppt.	P	0.01630	$\bar{2}.21219$
	P_2O_5	0.03731	$\bar{2}.57177$
	$Ca_3(PO_4)_2$	0.08147	$\bar{2}.91100$

Factors for Quantitative Analysis—*(continued)*.

Weighed as.	Required.	Factor.	Log.
Platinum.			
$(NH_4)_2PtCl_6$	Pt	0.43960	$\bar{1}.64306$
	$PtCl_4$	0.75904	$\bar{1}.88026$
	$PtCl_6$	0.91875	$\bar{1}.96319$
Pt	$PtCl_4$	1.72663	0.23720
	$PtCl_6$	2.08990	0.32013
K_2PtCl_6	Pt	0.40151	$\bar{1}.60370$
	$PtCl_4$	0.69327	$\bar{1}.84090$
	$PtCl_6$	0.83914	$\bar{1}.92383$
Potassium.			
KCl	K	0.52441	$\bar{1}.71967$
K_2SO_4	K	0.44875	$\bar{1}.65201$
	K_2O	0.54056	$\bar{1}.73285$
	KCl	0.85574	$\bar{1}.93234$
KNO_3	K	0.38672	$\bar{1}.58739$
K_2PtCl_6	K	0.16085	$\bar{1}.20643$
	K_2O	0.19376	$\bar{1}.28727$
	KCl	0.30674	$\bar{1}.48676$
	K_2CO_3	0.28428	$\bar{1}.45375$
$KClO_4$	K	0.28219	$\bar{1}.45054$
	KCl	0.53811	$\bar{1}.73087$
$K_2NaCo(NO_2)_6.H_2O$	K	0.17215	$\bar{1}.23591$
Silicon.			
SiF_4	SiO_2	0.57815	$\bar{1}.76204$
SiO_2	Si	0.46932	$\bar{1}.67147$
	SiO_3	1.26533	0.10220
	SiO_4	1.53066	0.18488
$BaSiF_6$	H_2SiF_6	0.51602	$\bar{1}.71267$
	SiO_2	0.21561	$\bar{1}.33367$
	SiF_4	0.37294	$\bar{1}.57163$
Silver.			
AgCl	Ag	0.75262	$\bar{1}.87657$
AgBr	Ag	0.57444	$\bar{1}.75924$
AgI	Ag	0.45945	$\bar{1}.66224$
AgCN	Ag	0.80572	$\bar{1}.90618$
Ag	AgCl	1.32870	0.12343
	AgBr	1.74085	0.24076

Factors for Quantitative Analysis—*(continued)*.

Weighed as.	Required.	Factor.	Log.
Sodium.			
Na_2O	Na	0.74194	$\bar{1}.87037$
NaCl	Na	0.39344	$\bar{1}.59487$
	Na_2O	0.53029	$\bar{1}.72451$
Na_2SO_4	Na	0.32381	$\bar{1}.51029$
	Na_2O	0.43644	$\bar{1}.63992$
	NaCl	0.82302	$\bar{1}.91541$
$Na_2H_2Sb_2O_7$	Na	0.11488	$\bar{1}.06025$
	Na_2O	0.15484	$\bar{1}.16938$
	NaCl	0.29200	$\bar{1}.46537$
Na_2CO_3	Na	0.43395	$\bar{1}.63743$
	Na_2O	0.58487	$\bar{1}.76706$
Strontium.			
$SrSO_4$	Sr	0.47706	$\bar{1}.67857$
	SrO	0.56417	$\bar{1}.75141$
SrO	Sr	0.84560	$\bar{1}.92716$
$SrCO_3$	Sr	0.59356	$\bar{1}$ 77346
	SrO	0.70194	$\bar{1}.84630$
Sulphur.			
$BaSO_4$	S	0.13734	$\bar{1}.13780$
	SO_2	0.27443	$\bar{1}.43843$
	SO_3	0.34297	$\bar{1}.53526$
	SO_4	0.41151	1.61438
	S_2O_3	0.24016	$\bar{1}.38049$
	H_2SO_4	0.42023	$\bar{1}.62349$
	Na_2SO_4	0.60858	$\bar{1}.78432$
	H_2S	0.14598	$\bar{1}.16429$
CdS	S	0.22193	$\bar{1}.34621$
	H_2S	0.23589	$\bar{1}.37270$
Tin.			
SnO_2	Sn	0.78766	$\bar{1}.89634$
	$SnCl_2$	1.25830	0.09978
Titanium.			
TiO_2	Ti	0.60051	$\bar{1}.77852$
Tungsten			
WO_3	W	0.79310	$\bar{1}.89933$
Uranium.			
U_3O_8	U	0.84808	$\bar{1}.92844$
$K_2U_2O_7$	U	0.71467	$\bar{1}.85410$
Vanadium.			
V_2O_5	V	0.56044	$\bar{1}$ 74853
Zinc.			
ZnO	Zn	0.80339	$\bar{1}.90492$
	ZnS	1.19737	0.07823
ZnS	Zn	0.67088	$\bar{1}.82664$
	ZnO	0.83516	$\bar{1}.92177$

GAS ANALYSIS.

In the qualitative examination of a gas the first observations are of colour, odour, combustibility, and ability to support combustion. Then it is ascertained whether the gas or part of it can be removed by certain absorbents. The unabsorbed gas is mixed with oxygen (or possibly hydrogen) and burnt; the product of this combustion is again treated with absorbents. If the gas is completely unabsorbed and incombustible it must consist of nitrogen and (or) some member of the argon group. Nitrogen combines with, and so may be removed by, metallic magnesium at a high temperature, or lithium at a low red heat.

REACTIONS OF GASES.

Acetylene.	Absorbed by Br water. Forms brick red ppt. with Cu_2Cl_2.
Ammonia.	Very soluble in water. Expelled from its aqueous solution on boiling. Absorbed by H_2SO_4.
Boron chloride.	Absorbed by water or KOH.
Boron fluoride.	Chars paper. Burns with a green flame. Very soluble in water.
Carbon disulphide.	Absorbed by alcoholic KOH.
Carbon dioxide.	Absorbed by KOH or soda lime.
Carbon monoxide.	Absorbed by Cu_2Cl_2 in hydrochloric acid or ammoniacal solution.
Chlorine.	Soluble in water. Removed by KOH or mercury.
Cyanogen.	Soluble in water (1 vol. dissolves 4½ vols.), alcohol (1 vol. dissolves 23 vols.) and absorbed by moist alkalies.
Cyanogen chloride.	Soluble in water (1 vol. dissolves 25 vols.), more so in alcohol. Absorbed by KOH.
Ethylene.	Absorbed by fuming H_2SO_4, Br water, or Cu_2Cl_2 solution.
Hydrogen.	Absorbed by palladium.
Hydrogen chloride, bromide or iodide.	Absorbed by water, KOH, or powdered borax.
Hydrogen cyanide.	Absorbed by water, alkalies, or mercuric oxide.
Hydrogen phosphide.	Slowly absorbed by $CuSO_4$ soln. Decomposed by Br or fuming H_2SO_4.
Hydrogen silicide.	Decomposed by KOH, 1 vol. giving 4 vols. H_2.
Hydrogen sulphide.	Soluble in water and KOH. Darkens lead acetate paper. Decomposed by Br or conc. H_2SO_4.
Methane.	Insoluble in water. Burns with faintly luminous flame.
Methyl, ethyl amines.	See ammonia.
Methyl chloride.	Soluble in water (1 vol. dissolves 4 vols.). Very soluble in alcohol.

Methyl ether.	Soluble in water (1 vol. dissolves 32 vols. at 10°) and H_2SO_4; very soluble in alcohol.
Nitric oxide.	Absorbed by Br water or $FeSO_4$ soln. Combines with oxygen giving nitrogen peroxide, which can then be absorbed by KOH.
Nitrous oxide.	With an equal vol. of hydrogen, gives an explosive mixture, leaving an equal vol. of nitrogen. Soluble in alcohol and water.
Nitrogen.	Insoluble. Combines at red heat with titanium, magnesium, and lithium.
Oxygen.	Absorbed by alkaline pyrogallol, phosphorus, cuprous chloride, or sodium hydrosulphite soln.
Silicon fluoride.	Absorbed and decomposed by water, with separation of gelatinous silicic acid.
Sulphur dioxide.	Soluble in water. Absorbed by KOH, dry PbO_2 and MnO_2.

EXAMINATION OF A GAS.

The gas is tested for colour, smell, and combustibility. It is then sparked, and note is taken of any change in volume, the formation of any coloured gas (*e.g.*, NO_2 from nitrogen and oxygen), or of any deposition of carbon, phosphorus, arsenic, sulphur, silica, etc.

A. If the gas is not combustible it is treated with strong potash solution.

I. No appreciable absorption :

(*a*) Gas ignites a glowing splinter of wood.	
Odourless, absorbed by alkaline pyrogallol, or sodium hydrosulphite soln.	**Oxygen.**
Peculiar odour, shows reactions of oxygen, attacks mercury, decomposes potassium iodide.	**Ozone.**
Odourless, unabsorbed by pyrogallol, fairly soluble in cold water and absolute alcohol.	**Nitrous oxide.**
(*b*) Gas does not support combustion.	
Absorbed by ferrous sulphate solution, gives red fumes when mixed with air.	**Nitric oxide.**
No positive reactions.	**Nitrogen.**

II. Absorption.

First note whether the gas will dissolve in water alone—ammonia, hydrochloric hydrobromic, or hydriodic acid, boron fluoride, silicon fluoride.

(*a*) The gas is of a yellow colour, and attacks mercury.	
Greenish yellow, strong smell, attacking the mucous membrane.	**Chlorine.**

Yellow, fairly soluble in water, explosive.	Chlorine monoxide
Greenish yellow, very explosive.	Chlorine dioxide.

(*b*) Yellowish red.	
Absorbed by ferrous sulphate solution, conc. H_2SO_4, and by water, with which it forms nitric and nitrous acids, and nitric oxide.	Nitrogen peroxide
(*c*) Reddish brown.	
Odour similar to, but stronger than, that of chlorine	Bromine.
(*d*) Colourless.	
Strong smelling, reacts alkaline with litmus, very soluble in water, white fumes with hydrochloric acid.	Ammonia.
Sharp smell, reacts acid, soluble in water, turns dichromate paper green.	Sulphur dioxide
Soluble in its own volume of water, gives with lime water a white ppt. soluble with excess of carbon dioxide.	Carbon dioxide.
Strong smell, decomposed slowly by water.	Cyanogen chloride
(*e*) Colourless, acid reaction, white fumes with ammonia.	
Decomposed by chlorine with separation of iodine or iodine monochloride.	Hydriodic acid.
Decomposed by chlorine with formation of bromine.	Hydrobromic acid.
Not decomposed by chlorine.	Hydrochloric acid.
Attacks glass.	Hydrofluoric acid.
Absorbed by water with separation of gelatinous silicic acid.	Silicon fluoride.
Gives dense fumes in the air, chars paper, very soluble in water, absorbed by turpentine.	Boron fluoride.

B. The gas is combustible.

Burns with a scarcely visible blue flame, forming water.	Hydrogen.
Bright blue flame, product carbon dioxide.	Carbon monoxide.
Blue flame, separation of sulphur on cold surface, and formation of acids containing sulphur.	Hydrogen sulphide, carbon oxysulphide or disulphide.
Red flame, separation of brown selenium.	Hydrogen selenide.
Brilliant yellow flame, formation of phosphoric acid, or deposition of phosphorus, often burns spontaneously.	Phosphine.
Bluish white flame, deposition of white arsenious oxide or brown arsenic.	Arsine.
Ruddy flame, deposition of white silica or brown silicon, often burns spontaneously.	Hydrogen silicide
Faintly luminous flame, formation of water and carbon dioxide.	Methane.

After this test the gas is treated with caustic potash solution.

I. Absorption.

Soluble in water, can be expelled from solution by warming with potash, gas and solution smell like ammonia, alkaline reaction, dense fumes with hydrochloric acid, and a ppt. with platinic chloride.	**Methyl and similar amines.**
Soluble in water, soluble in alcohol and ether.	**Methyl ether**
Gas dissolves slowly in water:	
1. Combustible with blue flame, sulphur and sulphur dioxide resulting, bad odour, ppts. many metals from their salt solutions.	**Hydrogen sulphide.**
2. Bad odour, brown selenium separates on burning.	**Hydrogen selenide.**
3. Burns with separation of tellurium.	**Hydrogen telluride.**
4. Burns with purple red flame, no water formed.	**Cyanogen.**

II. No absorption either by water or caustic potash solution.

Volume of gas quadruples on treatment with potash, burns depositing silica and brown silicon.	**Hydrogen silicide.**
Burns with blue flame, producing carbon dioxide but no water, absorbed by cuprous chloride.	**Carbon monoxide**
Burns forming water only.	**Hydrogen.**
Combustion results in separation of stable body, aqueous solution of which reacts acid; gives black ppt. with copper sulphate:	
1. Fishy odour, often spontaneously combustible, giving red phosphorus and phosphorus pentoxide, absorbed by acid cuprous chloride.	**Phosphine.**
2. Peculiar odour, burns to arsenious oxide, and deposits arsenic, absorbed by acid cuprous chloride, giving black ppt.	**Arsine.**
Burns to water and carbon dioxide, sometimes with separation of carbon:	
1. Unabsorbed by sulphuric acid, bromine, or ammoniacal cuprous chloride, slightly soluble in absolute alcohol.	**Paraffin hydrocarbons**
2. Burns with a luminous flame, unabsorbed by cuprous chloride, absorbed by bromine or fuming sulphuric acid. Very slowly absorbed by concentrated sulphuric acid.	**Ethylene.**
3. As ethylene, but easily absorbed by sulphuric acid.	**Propylene, butylene.**
4. Burns with smoky flame, absorbed by bromine, and by ammoniacal cuprous chloride, giving a red ppt.	**Acetylene.**

5. As acetylene, but giving yellow ppt. with cuprous chloride.	**Allylene.**
6. Burns with green mantled flame, can then be tested for halogens.	**Methyl chloride, ethyl chloride or fluoride.**

Absorbents.

Potash.	**400 grm. KOH dissolved in 1 litre of water.**
Bromine.	**Dissolved in a 5 per cent. solution of KBr until a fairly deep colour is obtained.**
Pyrogallol.	**10 gms. pyrogallol dissolved in 25 to 30 cc. water. *When required for use* one part of this solution is mixed with five times its volume of potash solution.**
Cuprous chloride.	**(i) Ammoniacal. Mix together 50 grm cuprous chloride and 25 grm. ammonium chloride, add 150 cc. water and pass in ammonia gas, shaking at frequent intervals until solution is complete.** **(ii) Hydrochloric acid. Dissolve 25 grm black copper oxide in concentrated hydrochloric acid, add 30 grm. copper, and boil under a reflux condenser until colourless. Dilute to 500 cc. with conc. hydrochloric acid.**

ANALYSIS OF GAS-MIXTURES.

Collection of the Gas. The gas is generally collected over mercury, and is usually saturated with water vapour, for which the volume must be corrected.

Correction for temperature and pressure.

Suppose b = barometric height.
b_1 = difference between levels of mercury in gas-vessel and trough.
t = temperature.
b_2 = vap. press. of water at that temp.
m = correction for meniscus.
v = vol. of gas.

Then volume of dry gas corrected to N.T.P. (0°C. and 760 mm. pressure) is :

$$\frac{(v + m)(b - b_1 - b_2)}{760 \times (1 + 0.00366\,t)}$$

$$\text{or } \frac{(v + m)(b - b_1 - b_2)\,273}{760 \times (273 + t)}$$

Calculation of Results. If a gas of unknown composition and volume M consists of carbon monoxide, v_1, hydrogen, v_2,

and methane, v_3, and if a known volume of this gas is mixed with air, the amount of each constituent can be found from observations of the volume of carbon dioxide, V, produced by combustion, and the total contraction, C, due to combustion and condensation of water formed.

The volume of the condensed water is negligible when compared with the original volumes of unburnt gases.

(i) $2CO(v_1) + O_2 = 2CO_2(v_4)$		$v_1 = v_4$
2 vols. 1 vol. 2 vols.		Contraction $= \frac{1}{2}v_1$
(ii) $2H_2(v_2) + O_2 = 2H_2O$		
2 vols. 1 vol.		Contraction $= \frac{3}{2}v_2$
(iii) $CH_4(v_3) + 2O_2 = CO_2(v_5) + 2H_2O$		$v_3 = v_5$
1 vol. 2 vols. 1 vol.		Contraction $= 2v_3$

$$V = v_1 + v_3$$
$$C = \tfrac{1}{2}v_1 + \tfrac{3}{2}v_2 + 2v_3$$
$$M = v_1 + v_2 + v_3$$

In more complicated mixtures it is necessary to remove and estimate all absorbable gases before combustion. In the above example the carbon monoxide might have been so determined.

A gas containing nitrogen as well as methane and hydrogen must be well diluted with air before combustion, in order to avoid the formation of oxides of nitrogen.

ESTIMATION OF CARBON DIOXIDE AND CARBON MONOXIDE IN THE AIR.

Carbon dioxide. The carbon dioxide from a known volume of air is absorbed by means of a standard baryta solution, and the excess baryta is titrated with oxalic acid, using phenolphthalein as indicator (Pettenkofer).

Required : (i) Soln. of oxalic acid, 5·63 grm. per litre, of which 1 cc. = 1 cc. CO_2; (ii) soln. of 200 grm. $Ba(OH)_2$ and 10 grm. $BaCl_2$ per litre; (iii) dilute baryta soln. containing 30 cc. of former soln. to 1000 cc. The strength of this last solution is determined by placing in a small flask nearly sufficient oxalic acid to neutralise 10 cc. baryta, then adding the baryta and neutralising by slowly running in more oxalic acid. By this means an accurate standardisation is made possible, as the solution is never so strongly alkaline as to absorb appreciable amounts of carbon dioxide from the air.

For the estimation of carbon dioxide, thick-walled conical Erlenmeyer flasks are used. They are furnished with double-

bored rubber stoppers, the holes in which are closed by short pieces of glass rod. The content of each flask is measured up to the point to which the rubber stopper reaches, and is marked on the outside of the flask. The simplest way of obtaining a sample of the air is to fill a flask with water, and empty it in the room, the air of which is to be tested. By means of a pipette 10 cc. baryta is run into the flask, the glass rods being removed from the holes in the stopper, and the point of the pipette being inserted through one of them. The flask is now stoppered up again, and should be shaken at intervals during half an hour, after which the glass rods are again removed, phenolphthalein is added, and oxalic acid is run in from a burette until the solution is colorless.

The difference between the titrations of fresh baryta and that in the flask gives the carbon dioxide content in cc. (Hesse's Method ; for further details see Hempel, *Gas Analysis*.)

Carbon monoxide. In small quantities (less than 1 per cent.) carbon monoxide can only be accurately estimated by means of blood, or by some oxidation method.

(i) Hæmoglobin, the colouring matter of blood, unites with oxygen and carbon monoxide, and the carbon monoxide compound dissociates less readily than the oxy-compound. The proportion of oxy-hæmoglobin to carbon monoxide hæmoglobin will be the ratio of the partial pressures of the gases in the mixture.

If the oxygen content of the air is known, the amount of carbon monoxide can readily be calculated if the proportion between oxy-hæmoglobin and carbon monoxide hæmoglobin in the blood is determined. This can be done colorimetrically, using a solution containing 1 gm. of carmine with a few drops of ammonia in 100 cc. glycerine diluted with water to 1 litre. A dilute solution of oxy-hæmoglobin is yellow, one of carbon monoxide hæmoglobin is rose-red.

A sample of air is taken by filling a flask of 250 cc. capacity with water and emptying it in the room. Now 5 cc. of a 5 per cent. aqueous solution of defibrinated ox-blood is run in, the bottle is stoppered up, and shaken for some minutes. The liquid is then brought into one of three exactly equal test tubes. The second tube contains 5 cc. of blood solution, and the third the same quantity saturated with carbon monoxide. To the first and second tubes carmine solution is added until the solutions have attained the same degree of colour as that of the liquid in the third tube. Then if x and y cc. are amounts of carmine solution added to the first and second tubes respectively, and S is the per cent. saturation

of the blood which was shaken with the air,

$$\frac{x}{x+5} \times \frac{y+5}{y} \times 100 = S$$

From the following table the content of carbon monoxide in the air can be obtained :

S.	10	20	30	40	50	60	70	80	90
CO per cent.	0.015	0.04	0.08	0.12	0.16	0.22	0.30	0.60	1.2

If the air contains more than 1 per cent. carbon monoxide the estimation is preferably carried out by absorption with cuprous chloride.

(ii) An oxidation method for the estimation of small quantities of carbon monoxide was described by Kinnicutt and Sandford (*J. Amer. Chem. Soc.*, 1900, 22, [1], 14–18; *J.S.C.I.*, 1900, 19, 275–276).

Good results were obtained by oxidising with iodine pentoxide, and titrating the liberated iodine with N/1000 sodium thiosulphate. The iodine pentoxide was contained in a small U-tube which could be heated to 150°C. by means of an oil-bath. This tube was connected to an absorption tube containing potassium iodide solution, and 250 cc. to 1000 cc. of gas was passed through, unsaturated hydrocarbons, hydrogen sulphide, sulphur dioxide and other reducing gases being removed before coming into contact with the iodine pentoxide. It was found that the presence of other constituents of coal gas had no effect, and the method is available for the determination of 0·0025 per cent. of carbon monoxide in air.

COAL GAS AND FUEL GASES.

Coal gas consists mainly of hydrogen, carbon monoxide, paraffins, chiefly methane, unsaturated hydrocarbons, vapours of benzene, toluene, etc. In addition there are usually present small quantities of carbon dioxide, oxygen, nitrogen, and sulphur compounds.

The various constituents are determined in the following order: Carbon dioxide by absorption with strong potash solution, benzene and unsaturated hydrocarbons by fuming sulphuric acid, oxygen by alkaline pyrogallol, and carbon monoxide by ammoniacal or hydrochloric acid cuprous chloride. Paraffins, hydrogen and nitrogen if necessary, remain to be determined by eudiometric combustion with excess air or oxygen. The contraction is noted, and the carbon dioxide formed is absorbed by potash. This absorption is equal to the volume of methane, as methane burns forming its own volume of carbon dioxide.

Then if C=contraction, and A=absorption, volume of

methane = A. Contraction due to methane = 2A, so contraction due to hydrogen = C − 2A, and volume of hydrogen = 2/3 (C − 2A). Nitrogen is obtained by difference.

It should be mentioned that the gas estimated as methane usually contains a small amount of ethane and possibly propane.

Total sulphur is usually determined by the "Referees' Method." A known volume of gas is burned at the rate of about 0·5 cu. ft. an hour in a small Bunsen burner, and the products of combustion together with some ammonia which is evaporated at the same time are passed upwards through a condensing tower filled with glass marbles to break up the stream of gas.

Bromine water or nitric acid may be allowed to trickle over these marbles, and all the sulphur is then obtained as a solution of ammonium sulphate at the bottom of the condenser. Barium chloride is added and the precipitated barium sulphate is filtered, ignited and weighed.

FIRE-DAMP.

Fire-damp is essentially a mixture of methane with air. Its explosiveness is greatest when the methane amounts to about 9.5 per cent., the oxygen of the air then being just sufficient for the combustion of the methane. Mixtures containing under 5 or over 14 per cent. methane are not inflammable, but are nevertheless dangerous, especially if coal dust is present.

The Grisoumeter of Coquillon is used for the determination of methane in fire-damp. A measured volume of the gas, after absorption of carbon di- and monoxides, is mixed with a suitable quantity of oxygen, and led either through a thin platinum tube (internal diameter about 1 mm.) heated by a Méker burner, as in some modifications of the Orsat apparatus, or over a spiral of platinum wire heated to redness by an electric current. The gas then burns quietly.

In the Grisoumeter of Le Chatelier the amount of the gas is measured by observations of the pressure registered on a small manometer, the gas-volume remaining constant, and changes of temperature being avoided by surrounding the burette with a large quantity of water. The combustion tube is also the measuring tube and is connected to a mercury aspirator and a manometer.

Observations are taken of the manometer height h, barometric height H, and temperature of water t, and a flame is

initiated, a known volume of methane being added, if necessary, to make the mixture burn. Height of manometer h^1, and temperature of water t^1, are again taken. Then the methane in 100 vols. of gas mixture

$$= \frac{1}{2}\left(\frac{h - h^1}{H + h - h^1} - \frac{t - t^1}{t + 273}\right)\frac{t + 273}{t^1 + 273}$$

or approx. $\dfrac{h - h^1}{2(H + h - h^1)}$.

THE ORSAT APPARATUS.

This apparatus is widely used for the analysis of flue gases, exhaust gases and other similar mixtures. The burette *A*, which has a capacity of 100 cc., is made narrow at the lower end and graduated in 1/5 cc. *A* is situated in a glass cylinder containing water and is connected at the bottom to a small levelling bottle by means of a rubber tube. *B*, *C* and *D* are absorption vessels which in order to increase the surface are filled with glass tubes. Each of these bulbs is connected at the lower end with another equally large vessel which serves as a reservoir for the absorbent. The cocks *b*, *c*, *d*, are simple glass cocks which in order to avoid danger of breakage are best connected by means of rubber tubes; *e* is a three way cock, being drilled axially through the stopper in addition to the usual transverse boring. The tube *f* is filled with cotton wool in order to filter any dust from the incoming gas. By simply moving the cock *e* it is possible to connect *f* with *A*, the outer air with *A* or the outer air with *f*.

B is filled with caustic potash solution, *C* with alkaline pyrogallol, and *D* with cuprous chloride solution. *E*, which is connected to the capillary main by a platinum tube, contains water or glycerine and water, and is used in the estimation of combustible gases. The cocks *b*, *c*, *d*, are closed, and *A* is connected to the outer air by means of the three-way cock, *e*; by raising the levelling bottle *F*, the burette *A* is filled to the upper mark with water; *e* is then closed, the levelling bottle lowered, and *a* opened. By this means *B* is filled with absorption solution. Similarly *C* and *D* are filled. The tube *f* can now be connected to the sample of gas to be analysed and by turning *e* so as to open to the outer air the tube can be washed with the gas sample by attaching a suction pump to the outlet. The three way cock is now turned to allow the passage of sample to *A*, which is filled with gas by means of the levelling bottle. This process is carried out twice to ensure the removal of air; *e* is then closed, *a* opened, and by means of *F* the gas is forced from *A* into *B*, where the carbon dioxide will be absorbed. The

process is now reversed and the gas returned to *A*. *F* is now adjusted until the levels of the water in *A* and *F* are the same when the volume of gas may be read on *A*. By subtracting this figure from the original volume (100 cc.) the volume of carbon dioxide absorbed is obtained. By the same means the

absorptions of gas in *C* and *D* yield the volume percentages of oxygen and carbon monoxide respectively. Care must be taken to avoid any of the absorption solutions passing into the horizontal capillary tubes.

For the estimation of methane and hydrogen 10 cc. of the

gas after the removal of absorbable constituents is made up to 100 cc. with air or oxygen. This mixture is passed slowly through the platinum tube *g*, heated to redness by a Méker burner, into the bulb *E*. In order to ensure complete combustion the gas should be passed through the heated platinum tube at least four times. It is then taken back into the burette *A*, and the contraction noted. The carbon dioxide produced by the combustion is estimated by absorption in potash. The amounts of methane and hydrogen can then be calculated as previously explained. Nitrogen is always estimated by difference. If it is required to determine unsaturated hydrocarbons the pyrogallol pipette may be disconnected at the rubber joint and temporarily replaced by one containing bromine water.

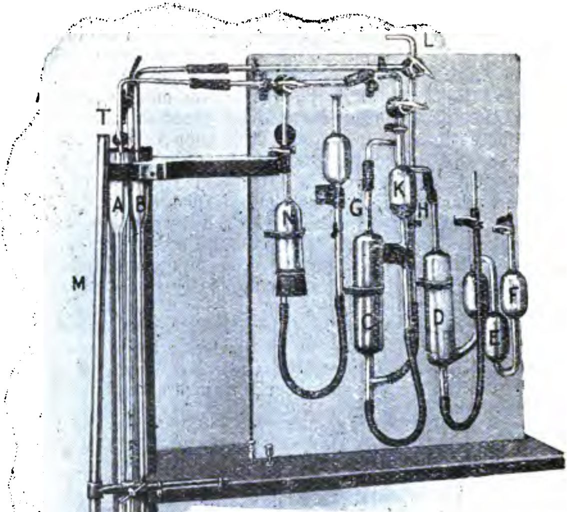
It should be remembered that after absorption with bromine water or cuprous chloride in hydrochloric acid the gas *must* be washed with potash before the reading is taken in *A*, as the vapour pressures of these absorbents are considerable.

THE HALDANE APPARATUS.

This apparatus is intended particularly for the analysis of air, but it is also useful for the determination of small quantities of methane or carbon monoxide in mine gases, etc. There are several modifications, full descriptions of which will be found in "Methods of Air Analysis" (J. S. Haldane). The diagram is of the form suited for use in a laboratory.

The gas is measured in the burette, A, which is about 800 mm. long. The upper wide part is of about 25 mm. bore, and has a capacity of 15 cc. The narrow part which is of about 3·5 mm. bore, is graduated to 0·01 cc. from 15 to 20 cc. The capacity is measured from the three-way tap, T, and does not include the bore. A water-jacket surrounds both the gas-burette and a compensation tube, B, the object of the latter being to nullify the effect of any changes of atmospheric pressure or temperature on the burette readings. One of the connections of the three-way tap is used for sampling, and the other is connected with the absorption pipettes, C and D, usually containing potash solution and alkaline pyrogallol respectively. The pyrogallol is protected from the atmosphere by potash solution in the bulbs, E and F. Before every burette reading the pressure should be adjusted by bringing the potash level to the mark, G, and using the pipette as a pressure gauge.

At the beginning of the analysis the tap, L, is opened to the atmosphere and by means of the levelling tube, K, and the

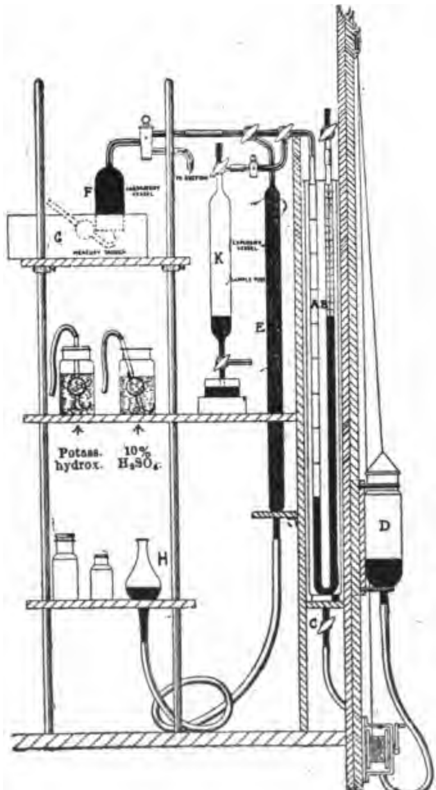


potash is adjusted to the mark H. The tap, L, is turned so as to connect the compensation tube with the potash pipette and remains in that position until the completion of the analysis. Before each reading of the burette the potash must be adjusted to H by means of K, and to G by means of the mercury levelling tube, M. The lower part of the compensation tube contains water, and the burette should be moistened with very dilute sulphuric acid.

Combustions are carried out in the pipette, N, by passing the gas mixed with air or oxygen if necessary, several times over a spiral of thin platinum wire strongly heated by an electric current.

BONE AND WHEELER APPARATUS.

There are several modifications of this apparatus; the diagram is of the form originally suggested for commercial gas analysis. (*J.S.C.I.*, 1908, **37**, 10.)



The apparatus consists of three main parts : (i) the measuring and pressure tubes, A and B surrounded by a water-jacket, and

connected to the mercury reservoir D; (ii) the explosion tube, E, connected to a separate mercury reservoir, H, and fitted with platinum electrodes and leading wires to an induction coil; (iii) the absorption vessel, F, standing over mercury in a wooden trough, G.

The gas is measured at constant volume, by means of the pressure which it exerts. For this purpose there is a series of "constant volume" marks in the measuring tube, A, each coinciding with a 100 mm. mark on the pressure tube, B.

The inner surfaces of the tubes, A and B, should be kept moist with dilute sulphuric acid. The moistening of A and B with the same liquid automatically eliminates the influence of water vapour on the measurements.

A small microscope is sometimes attached to facilitate the reading of the mercury level, and to avoid errors of parallax.

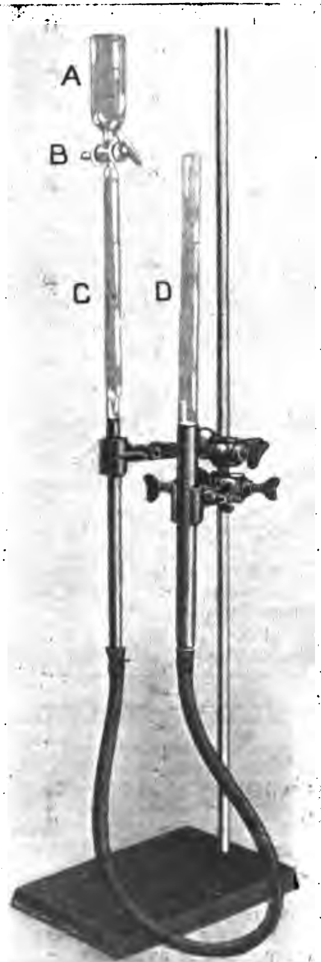
The gas for analysis may be introduced into the apparatus by means of the sampling tube, K, or simply from an ordinary test-tube under the wide end of the absorption vessel, F, which has been previously filled with mercury. Before measuring this gas the mercury level should be adjusted to the zero mark in A (by means of the reservoir, D, and the tap, C), and the reading taken in B. If this reading is not zero the necessary correction must be made on the reading of the sample of gas taken. It is very important that the mercury should be at the top of the pressure tube whenever any gas is admitted into the measuring tube.

The amount of gas originally taken should be as large as possible. Absorbable gases are removed in the laboratory vessel, F, 2 to 5 cc. of the absorbent being introduced by means of a suitably shaped pipette from below the surface of the mercury in the trough. After each absorption the gas is returned to the measuring tube, the pressure is read, and the decrease is noted. In the case of cuprous chloride it is more convenient to work with a solution in ammonia than with one in hydrochloric acid, and before taking the reading the gas must be washed with dilute sulphuric acid.

A suitable quantity of the residual gas is then mixed with oxygen or air, and after sparking in the explosion vessel, E, the contraction is noted, and any carbon dioxide formed is absorbed by means of potash.

After the completion of an analysis the whole apparatus should be washed out with sulphuric acid, in order to diminish the possibility of fouling by alkalies.

The Lunge Nitrometer.



In the nitrometer, nitric acid and nitrates may be estimated by measuring the volume of gas evolved on treatment with concentrated sulphuric acid in presence of mercury. Technically, the nitrometer is most frequently used in estimating the percentage of nitric acid in vitriol or in nitrating mixtures, so that snap samples of a nitrating mixture at various times may serve as a rapid method of estimating the course of a nitration.

The measuring tube C is filled with mercury by means of the levelling tube D, and a quantity of the acid under examination (the amount used being dependent upon the HNO_3 present) is run into A, and allowed to run into C. The cup A is washed with a further quantity of pure H_2SO_4, which is then run into C, so that the acid in C is approximately 80% H_2SO_4, taking care that no air bubbles pass into C. The tube C is then well shaken until no further gas is liberated, and the apparatus allowed to stand one hour. The mercury levels are adjusted so that the level in D is higher than that in C by an amount equal to 1/7th of the layer of H_2SO_4 present in C (to correct for gravity of H_2SO_4).

The volume of the gas, the temperature and pressure in the laboratory are taken, and then the gas volume is corrected to 0° and 760 mm., and from this the percentage of HNO_3 may be obtained.

Ammonium Salts by the Hypobromite method.

Ammonium salts are decomposed by an alkaline solution of sodium hypobromite; for example:

$$2NH_4Cl + 2NaOH + 3NaOBr = 2NaCl + 3NaBr + 5H_2O + N_2.$$

If the reaction takes place in a nitrometer, the nitrogen liberated may be measured.

Wt. of 1 cc. pure nitrogen at N.T.P. = 0·0012507 grm.

The hypobromite solution is prepared from 100 grm. of caustic soda solution (Sp. Gr. 1·1) and 4 grm. of bromine.

To correct for the solubility of nitrogen in the hypobromite solution, 2·5 per cent. of the volume of nitrogen found is to be added (Lunge).

Factors for Conversion of Volumes of Gas.

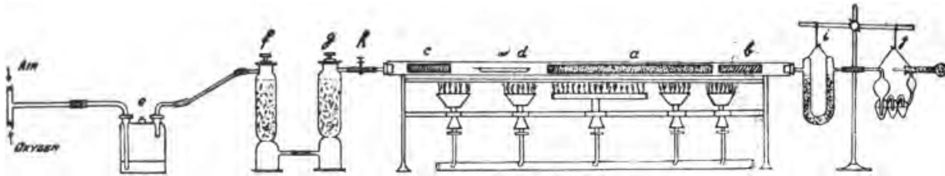
Substance	Method	Gas	1 cc. (N.T.P.) = mgrm.
Organic compds.	Dumas	N_2	1·2507 N_2
Chile saltpetre	Nitrometer	NO	3·795 $NaNO_3$
Nitrosyl sulphuric acid	,,	NO	1·697 N_2O_3 2·813 HNO_3 3·795 $NaNO_3$
Nitroglycerin	,,	NO	3·379 $CaH_5(NO_3)_3$
Pyrolusite	By H_2O_2	O_2	3·880 MnO_2
Bleaching powder	,,	O_2	1·583 Cl_2
$KMnO_4$	,,	O_2	0·7143 O_2
Carbonates	Decomp. HCl.	CO_2	4·468 $CaCO_3$

ULTIMATE ORGANIC SUBSTANCES.

Carbon and Hydrogen.

When it is necessary to find the quantitative ultimate composition of an organic substance, the analysis is made by means of a combustion.

A known weight of the substance is burnt in a tube containing copper oxide, the water and carbon dioxide evolved being collected; from the weight of these products the hydrogen and carbon in the substance may be calculated. The oxygen is generally determined by difference, as no satisfactory method for the estimation of oxygen in organic compounds is available.



The apparatus employed is shown in the accompanying diagram, the combustion taking place in a hard glass tube (about 30 inches long), which is heated by means of a special combustion furnace. The space *a* contains granulated copper oxide; *b* is a spiral of copper gauze employed to decompose any oxides of nitrogen formed by combustion; if the substance is known to be free from nitrogen, this may be omitted. The front end of the tube is empty to allow the insertion of the boat *d*. Next to the boat is placed a spiral of copper gauze, previously oxidised by heating to redness in the presence of air or oxygen, in order to prevent the volatile and gaseous products from diffusing backwards along the tube. Arrangements are made to allow the passage of both air and oxygen through the tube, both being previously passed through the same purifying devices *e*, *f*, and *g*. *e* is a wash-bottle containing concentrated sulphuric acid to remove dust and water; *f* and *g* are towers filled with sticks of caustic potash. Between *g* and the tube is a screw clip *h* to allow regulation of the rate of flow of the oxygen or air. At the far end of the combustion tube are connected a calcium chloride tube (*i*) for the absorption of water and potash bulbs (*j*) for the retention of carbon dioxide. In case no calcium chloride tube is attached to the potash bulbs it is necessary to employ a further U-tube packed with calcium chloride or soda lime to collect any moisture which the gases may have absorbed from the potash solution (40% KOH). This latter vessel is always weighed together with the bulbs. Previous to making an estimation, the apparatus should be carefully examined to ensure that all joints are completely gas-tight. The air and oxygen required may be contained in gas-holders.

The method of procedure is as follows: The tube is first heated for a period of one hour to remove completely dust and moisture, after which the front end is allowed to cool and the boat removed. 0·15 to 0·25 grm. of substance is weighed into the boat, and then the calcium chloride tube and potash bulbs are weighed and connected.*

The boat is now inserted in the tube and the diffusion spiral *c* returned. A current of air (about one bubble per second) is passed through the tube and the diffusion coil heated. When the coil *c* has attained a dull red heat, the boat is slowly heated. After the entire tube has become hot the air supply may be replaced by oxygen for a period of about one hour to ensure the complete combustion of all carbonised residue, after which the air supply is again connected, until the whole of the apparatus is filled with air. The calcium chloride tube and potash bulbs may now be disconnected and allowed to cool previous to weighing. The increase in weights of the calcium chloride tube and the potash bulbs show the yield of water and carbon dioxide respectively.

By multiplying the water yield by 2/18 (H_2/H_2O) the hydrogen content of the substance is obtained. Similarly the carbon content is calculated by multiplying the carbon dioxide yield by 12/44 (C/CO_2). The entire analysis requires a period of about four hours.

With substances containing sulphur the tube should be filled with lead chromate instead of copper oxide in order to retain the sulphur dioxide which is formed.

Halogens, Sulphur and Phosphorus.

Halogens may be estimated by the Carius method, which consists of heating the substance with a small quantity of concentrated nitric acid in the presence of silver nitrate. By this means the carbon and hydrogen are oxidised and the halogens form insoluble silver salts which can be estimated gravimetrically. The estimation is carried out in a sealed glass combustion tube, which is heated in a tube furnace provided with wrought-iron pipes, inside which the heating may take place, thus minimising any danger from bursting.

Sulphur may be estimated either by fusion and precipitation (as $BaSO_4$), or by oxidation with concentrated nitric acid by the Carius method (omitting the silver nitrate) and precipitation. Phosphorus may be oxidised by the Carius method, after which the estimation may be completed in the usual way.

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* If nitrogen or halogens are present in the substance, it will be necessary to reduce the copper spiral *b* by heating to redness and immersing in methyl alcohol vapour in a test-tube, removing the methyl alcohol by heating the spiral to about 200°C.

Volumetric Determination of Nitrogen. (Dumas).

A combustion tube 70 cm. long is filled in the following order: at the sealed end of the tube is placed a layer of 10 cm. of fragments of magnesite, held in position by a loose plug of asbestos, then a layer of 10 cm. of granular copper oxide, followed by 0·3–0·6 grm. of the substance and powdered copper oxide, then a layer of 40 cm. of granular copper oxide, and finally a roll 10 cm. long of copper gauze.

The end half of the magnesite is heated to replace the air in the tube by carbon dioxide. When this process is complete the gas evolved is completely soluble in caustic potash solution. This solution is contained over mercury in a volumenometer, provided with a levelling tube. The combustion is then made as usual, and the nitrogen evolved collected over the caustic potash solution. The remainder of the nitrogen is driven into the volumenometer by heating the remainder of the magnesite. After levelling, the temperature and volume of the gas and the barometric pressure are noted.

$$\% \text{ N} = \frac{V(b-f)}{760\,(1 + {}^{1}/_{273}\,t)} \times \frac{28{\cdot}02}{22403} \times \frac{100}{W} = K \times \frac{V(b-f)}{W}$$

where V = Volume of nitrogen in cc. at t°C. and barometric pressure b mm.

f = Vapour pressure of the caustic potash (Sp. Gr. 1·20) used at t°C. (See Vol. II.)

and W = Weight of substance used.

Table giving Values of K $\left(= \frac{100}{760(1 + {}^{1}/_{273}\,t)} \times \frac{28{\cdot}02}{22403}\right)$

°C.	K	°C.	K	°C.	K
0	0.00016457	11	0.00015819	22	0.00015230
1	16397	12	15764	23	15178
2	16337	13	15709	24	15127
3	16278	14	15654	25	15076
4	16219	15	15600	26	15026
5	16161	16	15546	27	14976
6	16103	17	15492	28	14926
7	16045	18	15439	29	14877
8	15988	19	15386	30	14828
9	15931	20	15334	31	14779
10	15875	21	15282	32	14730

Determination of Nitrogen. (Kjeldahl-Sunning).

0·2—2·0 grm. of the substance (such a quantity should be taken that the nitrogen content is equivalent to about 40 cc. N/10 acid) is heated cautiously in a long-necked resistance flask with about 20 cc. concentrated sulphuric acid until the first frothing subsides. The flame should not be allowed to reach that part of the flask above the liquid, as it has been stated that if the heating is too prolonged, or taken to too high a temperature, ammonium sulphate may be lost. The flask and contents are allowed to cool, and 10 grm. potassium sulphate and a small crystal of copper sulphate added. The flask is again heated until the contents are of a pale-green colour, cooled and diluted with about 500 cc. of water. 100 cc. of 30% caustic soda are poured carefully down the side, avoiding mixing, a few small pieces of porous pot added, and the flask connected to the distillation apparatus. The flask is then well shaken and the ammonia distilled into excess of N/10 acid (say 50 cc.), which is back-titrated with N/10 caustic soda to methyl red, cochineal or methyl orange.

In every case a blank experiment must be run by the side of the test experiment.

As an alternative to the potassium sulphate and copper sulphate, 0·5—1·0 grm. of metallic mercury may be used. In this case it is necessary to add 25 cc. 10% sodium sulphide solution before distillation.

The Kjeldahl method is not available for nitro-, nitroso-, azo-, or diazo-compounds, or for hydrazines, nitrates or nitrites, without further modification.

ELECTRO-CHEMICAL ANALYSIS.

Sources of Electrical Energy, etc.

The sources available for electro-deposition are accumulators, Gülcher thermopiles, Bunsen cells, etc., but the first-named are invariably used for electrochemical analysis.

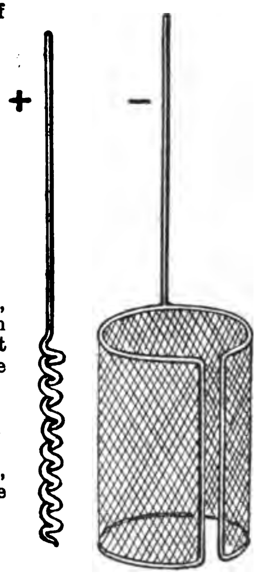
In order to obtain a satisfactory deposit, it is necessary to work at a suitable current density,

C.D. = amperes per square decimetre.

The current is adjusted by means of a rheostat.

$$C = \frac{E - e}{R}$$

where C = Current in amperes,
E = Main voltage,
e = Back E.M.F. in volts,
R = Resistance in ohms.



Apparatus.

A platinum dish may be employed as cathode, but this is much more expensive than the equally serviceable gauze cylinder or flag electrode.

The anode may be a cylinder, or, preferably, a piece of thick platinum wire coiled concentrically, the current being conducted by a portion of the wire bent vertically to the circle.

Platinum basins must not be heated direct, but should be heated on a water-bath.

For antimony, bismuth, mercury, and lead dioxide and manganese dioxide, a roughened gauze cathode is most satisfactory, but should not be finer than 70–80 meshes per sq. cm.

More rapid working is effected by the use of rotating electrodes. A suitable cathode for this purpose, for which a higher C.D. may be used, is a small sand-blasted cylinder of platinum gauze. It is more satisfactory to have a stationary cathode in the form of a platinum gauge cylinder, and to rotate rapidly the anode, which may be a spiral of iridio-platinum.

To prevent loss of liquid by spurting, due to liberation of gas, the containing vessel is covered with a watch-glass, pierced by a hole through which passes the thick vertical platinum wire which carries current to the anode.

The electrolysis is continued until a drop of the liquid on testing is found to be free from the metal which is being deposited. The current is discontinued until any liquid which would dissolve the deposit has been replaced by a syphoning arrangement. The cathode is then washed with water, alcohol, and ether, and then dried for a short time at 100°C., a higher temperature being necessary in the case of dioxide deposits.

In the following, several methods are outlined which have been suggested for electrochemical analyses and separations :

Antimony.

The precipitated antimony sulphide is dissolved in 80 cc. of saturated sodium sulphide solution (Na_2S). At ordinary temperature : C.D. = 0·3 ampere ; E.M.F. 1·5 volts.

At 50°C. : C.D. = 1 ampere ; E.M.F. = 2 volts.

The addition of 1 grm. potassium cyanide is an advantage, as it prevents formation of polysulphides.

Cadmium.

(1) A moderate excess of potassium cyanide is added to a solution containing 0·5 grm. of cadmium, preferably as sulphate or acetate.

C.D. = 0·6 ampere ; E.M.F. = 4·6 volts at ordinary temperature.
C.D. = 0·2 ampere ; E.M.F. = 4 volts at 50°C.

(2) 3 grm. of ammonium sulphate, acetate or formate are added to the cadmium solution, and then 1 cc. of a 20 per cent. solution of the corresponding free acid.

C.D. = 0·2 ampere ; E.M.F. = 2·5 volts at 60°C.

Copper.

(1) In absence of chlorides, bismuth, arsenic, antimony, tartaric and citric acids. To the solution of nitrate or sulphate, 5 per cent. of concentrated nitric acid is added.

C.D. = 1 ampere ($\frac{1}{2}$ ampere if other metal present) ; E.M.F. = 2·5 volts. It is preferable to warm the solution to 50°C. and to use stirring apparatus. The final solution is gradually syphoned off and replaced by water before breaking the current. When most of the copper has been deposited, about 0·5 grm. urea should be added to decompose any nitrite which may have been formed as this prevents complete deposition of copper.

(2) Potassium cyanide is added in slight excess until the yellow ppt. first produced has dissolved.

C.D. = 1 ampere ; E.M.F. = 5–6 volts (4–5 volts in warm solutions). About two hours are required for complete deposition.

Gold.

(1) If strongly acid the gold solution is almost neutralised with caustic potash. 2 grm. of pure potassium cyanide added to convert into the auricyanide.

At ordinary temperature: C.D. = 0·25 ampere; E.M.F. = 3 volts.

At 50°C.: C.D. = 0·7 ampere; E.M.F. = 3 volts.

(2) 30 cc. of saturated sodium sulphide solution are added, and the solution electrolysed at the ordinary temperature.

C.D. = 0·2 ampere; E.M.F. = 2 volts.

(3) 6 grm. of ammonium thiocyanate are dissolved in 60 cc. water, the solution warmed to 50°C., and the gold solution added with constant stirring.

At ordinary temperature or 50°C.: C.D. = 0·3 ampere; E.M.F. = 1·5 volts.

Iron.

The ferrous or ferric chloride or sulphate solution containing about 1 grm. of iron is almost neutralised with ammonia and poured into a concentrated solution of 6 grm. of crystallised ammonium oxalate, 5 cc. of a saturated solution of borax added, and the solution warmed.

C.D. = 0·6–1 ampere; E.M.F = 3·5 volts.

Lead.

A sand-blasted platinum dish or, preferably, gauze flag anode, roughened by a sand-blast, is used. The nitrate solution, containing 1 grm. of lead, should be free from silver and chlorine compounds. 20 per cent. of concentrated nitric acid is added.

C.D. = 0·5 ampere; E.M.F. = 2 volts at ordinary temperature.

In case metallic lead separates at the cathode, more nitric acid is added.

The deposit of lead dioxide is dried at 200°C.

Manganese.

A roughened anode must be used. To the manganese sulphate solution (containing 0·15 grm. manganese) are added 10 grm. ammonium acetate and 2 grm. of chrome alum (Engels, *Zeitschr. f. Elektrochem.*, **2**, 413), and the solution warmed to 75°C.

C.D. = 0·6 to 0·9 amperes; E.M.F. = 3·5 volts.

The deposit is washed, dried, and ignited to Mn_3O_4, which is then washed and reignited.

Mercury.

(1) 2 per cent. of nitric acid is added (5 per cent. in

presence of other metals), and the solution warmed to 50°C.
C.D. = 1 ampere (0·5 ampere in presence of other metals); E.M.F. = 4·0 volts. The cathode should be roughened.
(2) 1 per cent. of hydrochloric or sulphuric acid is added.
C.D. = 0·5–0·8 amperes (raised to 1 ampere towards end); E.M.F. = 3·5 volts.
The deposit must be dried in a dessicator, as alcohol loosens the globules.

Nickel or *Cobalt.*
The nickel sulphate solution (free from nitric acid) is added to a mixture of a concentrated solution of 5 grm. of ammonium sulphate and 30–40 cc. of concentrated ammonia solution (for 1 grm. nickel). The solution is stirred, but the deposition is carried out in the cold with C.D. = 1 ampere.
The process for cobalt is identical.

Silver.
3–4 grm. of pure potassium cyanide are added to the solution containing 0·5 grm. of silver.

C.D. = 0·3 ampere; E.M.F. 3·5 volts at ordinary temperature.
C.D. = 0·6 ampere; E.M.F. 5·6 volts at 50°C.

Tin.
If present in sodium sulphide solution, 20 grm. of pure ammonium sulphate are added, and the solution warmed until no more hydrogen sulphide is evolved, and then boiled for several minutes.
An excess of yellow ammonium sulphide is added to a solution containing 0·4 grm. tin, and the solution warmed to 50°C.
C.D. = 1 ampere (gradually reduced to 0·3 ampere); E.M.F. = 3·5 volts.
The electrolysis is continued until addition of an excess of hydrochloric acid gives a precipitate of pure sulphur.

Zinc.
Electrodes of nickel, or platinum coated with copper, are used.
4 grm. of potassium oxalate and 3 grm. of potassium sulphate are added to the neutral zinc sulphate or nitrate solution (0·3 grm. of zinc). The deposition is carried out with stirring in the cold.

C.D. = 0·5 ampere; E.M.F. = 4 volts.
After a short time, a few cc. of a 5 per cent. oxalic acid ˈution are added.

Electrolytic Separations.

Separation of Antimony and Tin.

The mixture of sulphides (0·5 grm. metal) is dissolved in 80 cc. of a saturated solution of sodium sulphide, 2 grm. of caustic soda added, and the solution warmed to 60°C. The antimony is deposited; C.D. = 0·5 ampere

After the antimony has been removed, the solution is boiled for 15 minutes with 25 grm. of ammonium sulphate. After cooling to 60°C., the solution is electrolysed; C.D. = 1·0 ampere.

Separation of Copper and Iron.

2 per cent. of sulphuric acid is added to a solution of the sulphates, and the warm solution electrolysed with C.D. = 1 ampere. After all the copper has been deposited, the cathode is removed and replaced by a fresh electrode. A solution containing 4 grm. of ammonium oxalate is added, the solution neutralised by suitable additions of ammonia or oxalic acid, heated to 50°C., and electrolysed with C.D. = 1 ampere.

Separation of Copper and Lead.

The anode used is a roughened flag electrode, a wire (bent as usual for an anode) being employed as cathode. 10 per cent. of concentrated nitric acid is added, and the solution warmed to 60°C.

C.D. = 1·5 amperes; E.M.F. = 1·5 volts.

The anode (on which lead dioxide has been deposited) is replaced by a fresh electrode to act as cathode in the electro-deposition of the copper, the current being reversed.

Separation of Copper and Silver.

The method used depends upon the variation of the E.M.F. in nitric acid or cyanide solution.

(1) In nitric acid solution, the silver is deposited first at below 1·3 volts.

(2) In cyanide solution, an excess of 4 grm. of potassium cyanide is used, and the silver is deposited first at below 1·6 volts. Before depositing the copper, sulphuric acid is added *in the fume cupboard* to decompose part of the potassium cyanide.

Separation of Copper and Zinc.

The copper is deposited from nitric acid solution, and the solution remaining evaporated with sulphuric acid before depositing the zinc in oxalic acid solution.

Separation of Lead and Silver.

10 cc. of concentrated nitric acid are added, the solution heated to 80°C., and electrolysed, using C.D. = 0·15 ampere. Silver is deposited on the cathode and lead dioxide on the anode.

Removal of deposits.

Antimony, by a mixture of nitric and tartaric acids.

Cobalt, by warming with concentrated nitric acid.

Gold, by warming with potassium cyanide solution to which has been added several cc. of hydrogen peroxide.

Iron, by warming with dilute sulphuric acid.

Lead dioxide, by warming with a mixture of glucose and nitric acid (1 : 1), or by adding dilute nitric acid and placing a piece of zinc or copper foil in contact with the electrode to form a galvanic couple.

Manganese oxide (Mn_3O_4), by warming with concentrated hydrochloric acid.

Mercury, by heating in a Bunsen flame.

Nickel, by warming with nitric or sulphuric acid, taking great care that all the deposit has been dissolved before heating the platinum electrode, as nickel tends to become "passive."

Silver, by potassium cyanide solution.

Tin, by boiling with concentrated hydrochloric acid, or by covering with dilute sulphuric acid and making anode with copper wire as cathode.

Zinc, by warming with a strong solution of caustic soda.

SPECTRUM ANALYSIS.

Flame Spectra.

Care must be taken to adjust the spectroscope so that the flame visible is above the blue cone; otherwise the green and blue bands of the carbon spectrum of the flame may interfere. The more characteristic lines in each spectrum are denoted by Greek letters. (See Diagram on next page.)

The wave-lengths (λ) are given in $\mu\mu$.

Taking Na = 50 on the scale of the spectrometer :

Kα	is at scale	division	17
Liα	,,	,,	32
Tl	,,	,,	68
Srδ	,,	,,	106
Inα	,,	,,	111
Inβ	,,	,,	149
Kβ	,,	,,	154
H	,,	,,	162

Sodium. Golden-yellow line at λ589·3 (D line); with fairly powerful spectroscope double line at λ589·6 and λ589·0.

Potassium. Red double line (α) at λ769·9 and λ766·5; violet line (β) at λ404·4.

Lithium. Red line (α) at λ670·8; faint golden-yellow line (β) at λ610·3.

Rubidium. Violet double line (α and β) at λ420·2 and λ421·5; red double line (γ and δ) at λ781·1 and λ795·0.

Cæsium. Blue double line (α and β) at λ455·5 and λ459·3.

(Rubidium and cæsium must be separated from large amounts of potassium and sodium salts, by fractional crystallisation of the acid oxalates, etc.)

Calcium. Golden-yellow band (α) at λ620·3 to λ618·2; yellowish-green band (β) at λ554·4.

Strontium. Red or golden-yellow bands are produced at λ686·3, λ674·4 (β), λ662·8 (γ). λ649·9, λ646·5, λ635·1, λ606·0 (α); blue line (δ) at λ460·7.

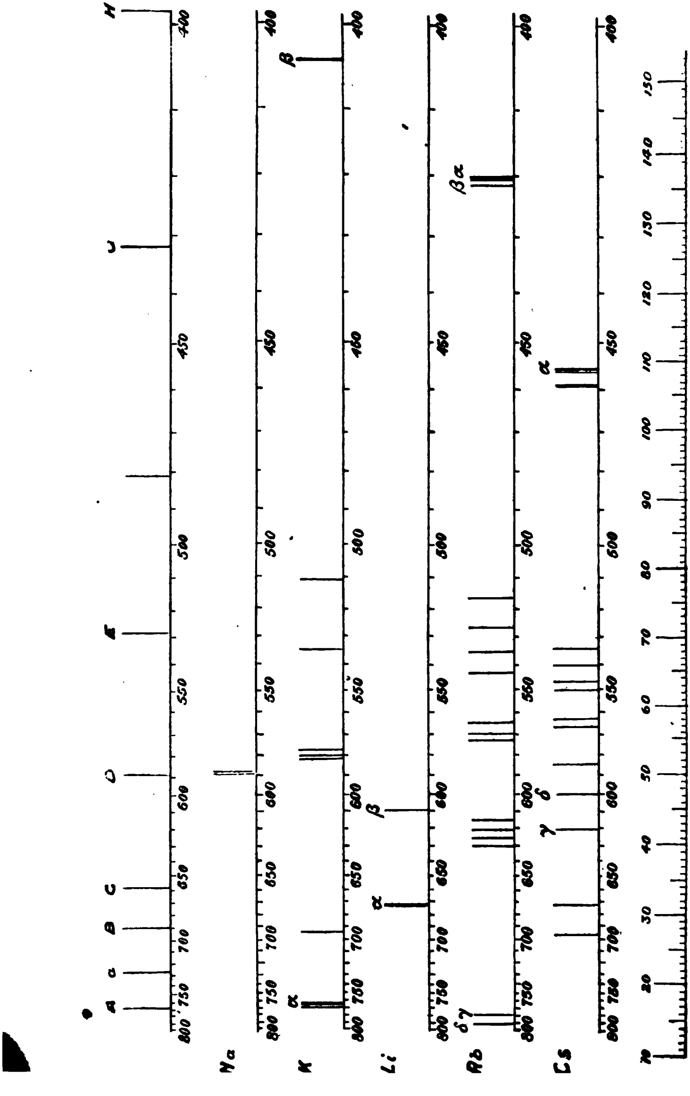
Barium. Green line (α) at λ553·5; green bands at λ534·7 (γ), 524·3 (δ), 513·7 (β), 500·0; blue band at 487·4.

Calcium, strontium, and barium in admixture. Only the following are characteristic :

Calcium : golden-yellow band (α).

Strontium : golden-yellow band (α); blue line (δ).

Barium : green bands (β, γ, and δ). [See p. 140.


A
a
B
C
D
E
F
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Li
Rb
Cs
α
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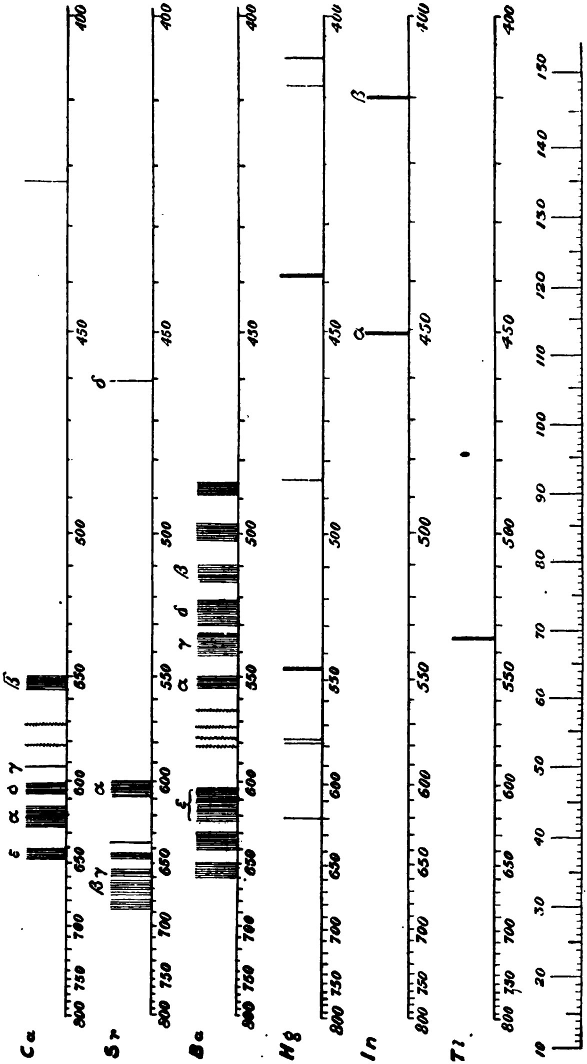
750
800


Ca
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60
70
80
90
100
110
120
130
140
150

Thallium. Green line at $\lambda 535 \cdot 0$.

Indium. Blue line at $\lambda 451 \cdot 1$; violet line at $\lambda 410 \cdot 1$.

Copper. Green lines at $\lambda 550 \cdot 7$ and $\lambda 538 \cdot 6$; blue bands at $\lambda 443 \cdot 7$ to $\lambda 441 \cdot 3$ and $\lambda 435 \cdot 4$ to $\lambda 433 \cdot 2$; continuous spectrum in yellow and green.

Manganese. Two golden-yellow bands; four green bands of which $\lambda 559 \cdot 2$, $\lambda 539 \cdot 2$ and $\lambda 515 \cdot 8$ are characteristic.

Boric acid. Four golden-yellow and yellow bands; two green bands; two blue bands. Yellow band at $\lambda 548 \cdot 1$ to $\lambda 544 \cdot 0$ and green bands at $\lambda 519 \cdot 3$ and $\lambda 491 \cdot 2$ are characteristic.

Spark Spectra.

Only the wave lengths of the stronger lines are mentioned.

Iron. Green lines at 537·0, 532·6, 526·6, 523·2, 519·2, 516·8, 513·9, 495·9, 492·3; blue lines at 489·1, 487·4.

Nickel. Green lines at 547·7, 508·1; blue line at 471·5.

Cobalt. Green lines at 535·3, 534·0, 528·0, 526·7.

Chromium. Green line at 520·7; blue lines at 429·0, 427·5, 425·4.

Manganese. Golden-yellow line at 601·7; blue lines at 482·4, 478·4, 476·6, 475·4.

Zinc. Golden-yellow line at 536·6; blue lines at 481·0, 472·2, 468·0.

Cadmium. Red line at 643·9; green line at 508·6; blue lines at 480·0 and 467·8.

Magnesium. Green line at 518·3.

Antimony. Golden-yellow line at 600·5; green line at 556·8.

Bismuth. Green line at 555·2; blue line at 472·4.

Lead. Green line at 500·5; violet line at 405·8.

Mercury. Green line at 546·1; blue line at 435·8.

Tin. Yellowish-green line at 563·2; blue line at 452·5.

Copper. Green lines at 521·8, 515·3.

Silver. Green line at 546·5.

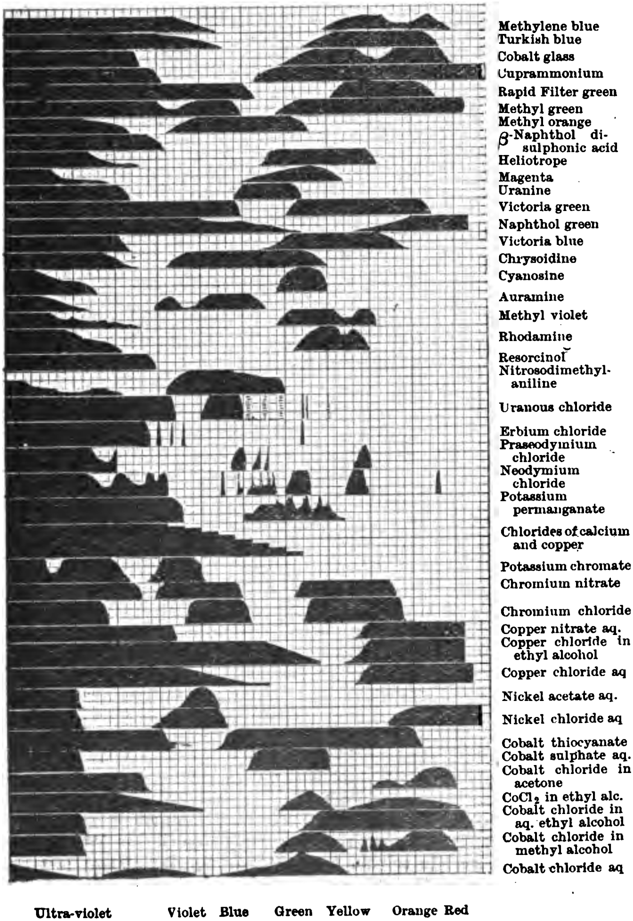
Gold. Golden-yellow line at 627·8; yellow line at 583·7.

Platinum. Green lines at 547·6, 530·2.

Palladium. Green lines at 529·6, 511·7.

Absorption Spectra.

The diagram below (Wood, "Physical Optics") gives the absorption spectra of certain dyestuffs and other substances which give coloured solutions.



GENERAL PROPERTIES OF INORGANIC

If water of crystallisation in ( ),
Salts of Organic Acids will be found

	Name.	Formula.	Formula Weight.	Density. Water=1 D:Air=1
1	Alum, ammonium	$Al_2(SO_4)_3(NH_4)_2SO_4+24H_2O$	907.9	1.6357/0°
2	— chrome	$Cr_2(SO_4)_3K_2SO_4+24H_2O$	998.9	1.83
3	— iron	$Fe_2(SO_4)_3(NH_4)_2SO_4+24H_2O$	964.4	1.712
4	— potash	$Al_2(SO_4)_3K_2SO_4+24H_2O$	949.1	1.751/17°
5	— silver	$Al_2(SO_4)_3Ag_2SO_4+24H_2O$	1086.7	
6	— sodium	$Al_2(SO_4)_3Na_2SO_4+24H_2O$	916.9	1.675/20°
7	Aluminium	Al	27.1	2.583
8	— bromide	$Al_2Br_6(+12H_2O)$	533.7	2.54
9	— carbide	Al_4C_3	144.4	2.36
10	— chloride	$Al_2Cl_6(+12H_2O)$	267.0	D:9.34/400° 4.51/835°
11	— fluoride	Al_2F_6	168.2	3.1
12	— hydroxide	$Al_2(OH)_6$	156.2	2.23
13	— iodide	$Al_2I_6(+12H_2O)$	815.7	2.63
14	— nitrate	$Al_2(NO_3)_6+18H_2O$	750.6	
15	— nitride	AlN	41.1	
16	— oxide	Al_2O_3	102.2	3.75—4.0
17	— phosphate	$Al_2(PO_4)_2$	244.3	2.59
18	— sulphate	$Al_2(SO_4)_3$	342.4	2.74
19	— sulphate	$Al_2(SO_4)_3+18H_2O$	666.8	1.69
20	— sulphide	Al_2S_3	150.4	2.37
21	Ammonia	NH_3	17.03	liq.:0.6234

Notes.—s. soluble; i. insoluble; v.s. very soluble; s.s. slightly soluble; v.s.s. very slightly soluble; m. miscible in all proportions; c. cold; h. hot; alc. alcohol; alk. alkalies; ac. acids; liq. liquid; gas. gaseous; $>H_2O$, $<H_2O$, heavier, lighter than water; d. decomposed; an. anhydrous. In the fourth column, D. represents the density of the gaseous form. In column nine, the sign aq., 2aq., 3aq., with a temperature signifies that the compound loses 1, 2, or 3 molecules of

SUBSTANCES. (See also "Minerals," Vol. II.)

not included in formula weight.
in the Tables of Organic Compounds.

Crystalline form and colour	Solubility* in 100 parts water at 15°C(60°F)	100 parts water at 100°C(212°F)	Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
I. C.	11.4	421.9	i. alc.			1
I. R.	15	green at 70°	i. alc.	22aq 200 24aq 400		2
I. Viol.	14.3(20°)	400	i. alc.	24aq 230		3
I. C.	9.6	357.5		84.5	18aq 60 24aq R.H.	4
	d.					5
I.	110	v.s.	i. alc.	24aq 50		6
B.W.	i.	i.	s. alk., HCl, H_2SO_4	658.7		7
C.	s.	s.	s. alc., CS_2	93	263	8
G. cryst.	gives CH_4					9
III.	s.	loses HCl	s. alc.		182/752 mm.	10
IIIa. C.	an. i. +7aq. s.		i. alc., alk., ac.			11
Am. W.	i.	i.	s. ac., alk.	at 300: $Al_2O_4H_2$		12
W.	an. i. +12aq. s.		s. alc., CS_2	185	360	13
	v.s.	v.s.	s. alc.	73	d. 134	14
Y. cryst.	d.			d. 135		15
III. Am.	i.	i.	s. H_2SO_4			16
III. C.	i.	i.	s. alk., ac., i. acetic			17
W.	35	89.1	s.s. alc.			18
V. C.	102	1132				19
Y. cryst.	d.			d.		20
	597 vols.	i.	v.s. alc.	-75	-33.5	21

water at that temperature. R.H. red heat; W.H. white heat; C. colourless; W. white; R. red; P. pink; B. blue; Y. yellow; G. green; Br. brown; Bl. black; Gr. grey; Viol. violet; L. lilac; Or. orange; expl. explodes; diss. dissociates.

Crystal forms (see "Crystallography," Vol. II.): I. cubic; II. tetragonal; III. hexagonal; IIIa. rhombohedral; IV. rhombic; V. monoclinic; VI. triclinic; Am. amorphous.

* Parts anhydrous substance unless otherwise stated.

Name.	Formula.	Formula Weight.	Density. Water=1 D : Air=1
1 Ammonium auriohloride	NH_4AuCl_4	357.1	
2 — auricyanide	$Au(CN)_3NH_4CN+H_2O$	337.3	
3 — aurocyanide	$Au(CN)_2NH_4CN$	293.3	
4 — bicarbonate	NH_4HCO_3	79.05	1.586
5 — borofluoride	NH_4BF_4	105.0	1.851/17°
6 — bromide	NH_4Br	97.96	2.379/4° D : 1.67/440°
7 — carbamate	$NH_4HCO_3+NH_4CO_2NH_2$	157.12	
8 — carbonate	$(NH_4)_2CO_3+H_2O$	114.1	
9 — chlorate	NH_4ClO_3	101.50	
10 — chloride	NH_4Cl	53.50	1.532
11 — chromate	$(NH_4)_2CrO_4$	152.08	1.886/11°
12 — chromic sulphate	$Cr_2(SO_4)_3(NH_4)_2SO_4+24H_2O$	956.71	1.736/21°
13 — cyanate	NH_4CNO	60.06	
14 — cyanide	NH_4CN	44.06	D : 0.79/100°
15 — dichromate	$(NH_4)_2Cr_2O_7$	252.08	2.367
16 — ferricyanide	$2(NH_4)_3Fe(CN)_6+H_2O$	550.05	
17 — ferrocyanide	$(NH_4)_4Fe(CN)_6+3\ H_2O$	338.2	
18 — fluoride	NH_4F	37.0	
19 — hydrogen fluoride	$NH_4F\ HF$	57.0	1.210/12°
20 — — phosphate	$(NH_4)_2HPO_4$	132.13	1.803/20°
21 — — sulphide	NH_4HS	51.11	
22 — hypophosphite	$NH_4H_2PO_2$	83.10	2.515
23 — iodide	NH_4I	144.96	D : 2.51/440°
24 — iridichloride	$(NH_4)_2IrCl_6$	456.0	
25 — magnesium arsenate	$Mg(NH_4)AsO_4+6\ H_2O$	289.42	
26 — — phosphate	$Mg(NH_4)PO_4+6\ H_2O$	245.5	1.65
27 — molybdate	$(NH_4)_6Mo_7O_{24}+4\ H_2O$	1236.3	2.498
28 — nitrate	NH_4NO_3	80.05	1.72/15°
29 — nitrite	NH_4NO_2	64.05	1.69
30 — palladichloride	$(NH_4)_2\ PdCl_6$	355.5	2.418

Crystalline form and colour	Solubility* in 100 parts water at 15°C (60°F)	100 parts water at 100°C (212°F)	Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
	v.s.	v.s.		an. at 100		1
Plates	s.		s. alk.	d.		2
C.	s.		s. alk.	d. 150—200		3
IV. W.	18.5	d.	i. alc.	d. 60		4
III. prism	25	100	s. alk.			5
I. C.	66	128	s.s. alc.	d.		6
W. cryst.	25	70 (65°)	d. by alc.		subl.	7
C.	100	d. 70—75°	s. alc.	d. 85°		8
V.	s.	s.	v.s.s. alc.	expl. 102		9
I. or II. C	35.2	77.3	v.s.s. alc.		diss. 350	10
V. Y.	40.5/30°	d.		d.		11
I. Oct.	12.1	green at 70°		18aq 100 22aq>100		12
	s.	d.	s.s. alc.	d.		13
I. C.	s.	d.	s. alc.		diss. 36	14
V. G.R.	47.2/30°	v.s.		d. to Cr_2O_3		15
R. prism.	s.	s.				16
Y. prism.	v.s.	d.	i. alc.			17
III. C.	deliq.	v s.	s.s. alc.		subl.	18
IV. C.	deliq.	v.s.			diss.	19
V. C.	25	s.	i. alc.			20
IV. C.	s. 128.1 (0°)	s.	s. alc.	subl.		21
III. W. plates	s.	s.	v.s. alc.	200	d. 240	22
I.	deliq. 167	v.s.	s. alc.			23
R. pdr.	0.699	1.266 (39°)				24
II.	0.17	i.	i. alc.			25
II.	0.005	i.	i. alc.			26
IV. C.	40	s.		d.		27
IV.	106	v.s.	s. in 67% alc.	152	d. 210	28
W.	v.s.	d. 50°		d.		29
I. R.	s.s.	s.s.				30

Name.	Formula.	Formula Weight.	Density. Water=1 D : Air=1
1 Ammonium perchlorate	NH_4ClO_4	117.50	1.87
2 — permanganate	NH_4MnO_4	136.97	
3 — persulphate	$(NH_4)_2S_2O_8$	228.20	
4 — phosphomolybdate	$(NH_4)_3PO_4.10MoO_3+3\ H_2O$	1643.2	
5 — platinibromide	$(NH_4)_2PtBr_6$	710.8	4.2
6 — platinichloride	$(NH_4)_2PtCl_6$	444.0	3.065
7 — sequicarbonate	$2NH_4HCO_3(NH_4)_2CO_3+H_2O$	272.2	
8 — sannichloride	$(NH_4)_2SnCl_6$	367.5	
9 — sulphate	$(NH_4)_2SO_4$	132.14	1.77/20°
10 — thiocyanate	NH_4CNS	76.12	1.3057/13°
11 Antimonic acid	$HSbO_3$	169.2	6.6
12 Antimonious acid	$HSbO_2$	153.2	
13 Antimony	Sb	120.2	6.62
14 — chloride (basic)	$2SbOCl;Sb_2O_3$	631.7	
15 — hydride (stibine)	SbH_3	123.2	D :4.36/15°
16 Antimonyl sulphate	$(SbO)_2SO_4$	368.5	4.89
17 —— (basic)	$(SbO)_2Sb_2(OH)_4SO_4$	676.9	
18 Antimony oxychloride	$SbOCl_3$	242.6	
19 — oxychloride	SbOCl	171.7	
20 — pentachloride	$SbCl_5$	297.5	2.316
21 — pentafluoride	SbF_5	215.2	2.993/23°
22 — pentasulphide	Sb_2S_5	400.8	4.12/0°
23 — pentiodide	SbI_5	754.8	
24 — pentoxide	Sb_2O_5	320.4	3.8
25 — sulphate	$Sb_2(SO_4)_3$	528.6	
26 — tetroxide	Sb_2O_4	304.4	4.07
27 — tribromide	$SbBr_3$	360.0	4.148/23°;
28 — trichloride	$SbCl_3$	226.6	D :7.96,3.06/26° 2.67/72°

Crystalline form and colour	Solubility* in 100 parts water at 15°C (60°F)	100 parts water at 100°C (212°F)	Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
IV.	20		s.s. alc.	d.		1
Needles	8.0			slowly heated—d.	rapidly heated—expl. d.	2
V.	58.2 (0°)	d.				3
Y.	0.03		i. alc.			4
I. Oct.	0.5			d.		5
Y.	0.67	12.5		d.		6
IV.	20	d.		d.		7
I. P.	33.3	s.				8
IV. C.	74.2	103.3	i. alc.	140	d. 280	9
V. C.	162.2 (20°)		s. alc.	149.5	d. 170	10
W.	s.s.	s.s.	s. ac., s. KOH			11
	i.	i.	i. alc.	d.		12
IIIa. W.			s.h. HCl., s. H_2SO_4	630.0	R.H.	13
III. W.	i.			d.		14
W.	20 vol.		1500 vol. in alc.	−91.5	−18	15
W.	d.					16
W.	i.	d.				17
Y.	d.		s. alc.			18
I., IIIa.	i.	d	i. alc., s. HCl, CS_2	d.	d.	19
V. W.	d.			−6	102/68 mm.	20
	s.		s. KF soln.		155	21
Or.	i.	i.	s. NH_4HS	d.		22
Br.					78—79	23
Y.W.	v.s.s.	i.	s. HCl, s.s. KOH	d. 300		24
W. needle	d.					25
W.	i.	i.	s. alk., s.s. ac.	infusible		26
IV. C.	d.			93	280	27
IV. C.	s., quickly d.		s. conc. HCl, s. alc.	73.2	223	28

Name.	Formula.	Formula Weight.	Density. Water=1 D : Air=1
1 Antimony trifluoride	SbF_3	177.2	
2 — —, sodium sulphate	SbF_3, Na_2SO_4	319.3	
3 — tri-iodide	SbI_3	501.0	(1) 4.85/26° (2) D : 17.6 (3) 4.77/22°
4 — trioxide	Sb_2O_3	288.4	5.556 nat.; 5.2 (1)
5 — trisulphide	Sb_2S_3	336.6	(1) 4.65 (2) 4.15
6 Argon	A	39.88	
7 Arsenic, cryst.	As	74.96	5.73/14°
8 — amorph.	As	74.96	4.71
9 — acid, ortho-	$2AsO(OH)_3+H_2O$	301.98	2—2.5 gas
10 — — pyro-	$As_2O_3(OH)_4$	265.95	
11 — — meta-	$AsO_2.OH$	123.97	
12 — di-iodide	As_2I_4	657.60	
13 — disulphide	As_2S_2	214.04	3.54
14 — hydride (arsine)	AsH_3	77.98	
15 — — (solid)	As_2H_2	151.94	
16 — oxychloride	$AsOCl$	126.42	
17 — pentasulphide	As_2S_5	310.20	
18 — pentoxide	As_2O_5	229.92	3.754
19 — phosphide	AsP	106.00	
20 — selenide	As_2Se_3	387.51	4.75
21 — tribromide	$AsBr_3$	314.72	3.7/15°
22 — trichloride	$AsCl_3$	181.34	2.205/0°
23 — trifluoride	AsF_3	131.96	2.666
24 — tri-iodide	AsI_3	455.72	4.4/13°
25 — trisulphide	As_2S_3	246.10	3.46; amorph. 2.76

Crystalline form and colour	Solubility* in 100 parts water at 15°C (60°F)	100 parts water at 100°C (212°F)	Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
	s., d.			292		1
	s.	s.				2
(1) III. R (2) IV. Y. (3) V. R.	d.		s. alc., CS_2, HCl	167 subl. 114	401	3
IV., 1.	i.		s. conc. HCl, tartaric acid	R.H.	subl. 1550	4
(1) III. Bl (2) Am. Br	i.	i.	s. am. sulph.	555	diss.	5
	4 (20°)			−189.6	−186.1	6
Gr.Bl.	i.	i.	s. ac.	subl. 450		7
Y. vapour	i.	i.	s. CS_2	subl.		8
W. cryst.	16.7	50		aq 180		9
	becomes ortho			d. 206 to meta		10
	becomes ortho			d. R.H.		11
R. prism		d.	s. alc., ether, CS_2, $CHCl_3$			12
V. R.	i.	i.	s. KHS, $NaHCO_3$	fusible		13
	5 vols.	s.s.	s.s. alc.	−113	−54.8	14
Br.	i.			d. 200		15
Br.	d.			fusible	d.	16
Y.	i.	i.	s. alc.	fusible	subl.	17
Am. W.	245	v.s.	v.s.	R.H.	d.	18
Br.R. pdr.	d.		i. ac., alc.	d.	d.	19
C. cryst.	i.	d.	s. alk.	360		20
	d.		s. HCl	31	221/745	21
	s., rapid d.		s. HCl, alc.	liq. −18	130.2	22
	d.		s. NH_3 soln.	−8.5	60.4	23
IIIa. Y.	s.	d.	s. alc., ether	subl. 146	394—414	24
Y	i.	i.	s. alc.		>700	25

Name.	Formula.	Formula Weight.	Density. Water=1 D : Air=1
1 Arsenious oxide	As_2O_3	197.92	cryst. 3.699; amorph. 3.738
2 Auric chloride	$AuCl_3$	303.6	3.9
3 — cyanide	$Au(CN)_3+3\,H_2O$	329.3	
4 — hydroxide	$Au(OH)_3$	248.2	
5 — oxide	Au_2O_3	442.4	
6 Auro-auric sulphide	Au_2S_2	458.5	
7 Aurous bromide	$AuBr.$	277.1	
8 — chloride	$AuCl$	232.7	
9 — cyanide	$AuCN$	223.2	
10 — hydroxide	$AuOH$	214.2	
11 — iodide	AuI	324.1	
12 — oxide	Au_2O	410.4	3.6
13 — — sulphide	Au_2S	426.5	
14 Azoimide	N_3H	43.04	
15 Barium	Ba	137.37	3.78
16 — bromate	$Ba(BrO_3)_2(+H_2O)$	393.21	4.04/17°
17 — bromide	$BaBr_2+2\,H_2O$	333.24	3.85/24°
18 — carbide	BaC_2	161.38	3.75
19 — carbonate	$BaCO_3$	197.37	4.275
20 — chlorate	$Ba(ClO_3)_2+H_2O$	322.31	3.179
21 — chloride	$BaCl_2+2\,H_2O$	244.32	3.1/24°
22 — chromate	$BaCrO_4$	253.4	3.9
23 — dithionate	$BaS_2O_6+2\,H_2O$	333.52	4.536/13.5°
24 — ferrocyanide	$Ba_2Fe(CN)_6+6\,H_2O$	594.77	
25 — fluoride	BaF_2	175.4	ppd. 4.828
26 — hydride	BaH_2	139.39	4.21/0°
27 — hydrogen phosphate	$BaHPO_4$	233.42	4.165
28 — — sulphide	$Ba(HS)_2(+4\,H_2O)$	203.51	

Crystalline form and colour	Solubility* in 100 parts water at 15°C (60°F)	100 parts water at 100°C (212°F)	Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
Am., I.; W	1.7	9.5	s. HCl.	subl. 218		1
Y.R.	68	s.	s. alc.	subl.	d. 180	2
C. plates	v.s.	d.		50	d.	3
Y.Br.	i.	i.	s. HNO_3	d.		4
Bl.	i.	i.	s. HCl	d.>100		5
Bl.	i.	i.	s. am. sulph.	d.		6
G.	i.		d. ac.	d.>150		7
Y.	d.			d.		8
Y.	i.	i.	i. alc., s. KCN	d.		9
R.B.	s. →blue			d. 250		10
Y.	i.	d.		d.<120		11
Br.Bl.	i.	i.	s. HCl	d. 250		12
Dark pdr.	an. i.		s. KCN			13
C.	m.	m.	s. alc., alk.	liq.	37	14
W.	d.			850	1000	15
V. C. cryst	0.7	5.4		d. 260		16
IV.	103	204	s. alc.	880 2 aq, 120		17
Bl. cryst.	gives acetylene					18
IV. W.	i.	i.	i. alc	795	d. 1450	19
V.	33.4	126	s.s. alc.	an. 414	(+aq 120)	20
IV.	34.5	58.8	i. alc., s.s. HCl, HNO_3	2aq, 113 960		21
Y.	i.	i.	s. ac.			22
IV.	24	90.9		d.		23
Prism.	0.17	0.9				24
Am., W.	v.s.s.		s. NH_4Cl; s. HF	1280		25
Gr.	d.			abt. 1200	1400	26
IV.	i.	i.	s. ac., s. NH_4Cl			27
IV.	s.	s.	i. alc.	d. 50		28

Name.	Formula.	Formula Weight.	Density. Water=1 D:Air=1
1 Barium hydroxide	$Ba(OH)_2+8\,H_2O$	315.52	an. 4.495
2 — hypophosphite	$Ba(H_2PO_2)_2+H_2O$	285.50	2.89/17°
3 — iodate	$Ba(IO_3)_2$	487.21	4.998
4 — iodide	$BaI_2+2\,H_2O$	427.24	an. 4.917
5 — manganate	$BaMnO_4$	256.3	4.85
6 — monoxide	BaO	153.37	4.7—5.5
7 — nitrate	$Ba(NO_3)_2$	261.39	3.24/23°
8 — nitrite	$Ba(NO_2)_2$	229.39	
9 — perchlorate	$Ba(ClO_4)_2$	336.29	
10 — peroxide	BaO_2	169.37	4.958
11 — — (hydrate)	$BaO_2+8\,H_2O$	313.50	
12 — persulphate	$Ba(SO_4)_2+4\,H_2O$	401.55	
13 — phosphate, ortho	$Ba_3(PO_4)_2$	602.19	4.1
14 — —, pyro	$Ba_2P_2O_7$	448.82	3.9/20°
15 — platinichloride	$BaPtCl_6+4\,H_2O$	617.4	2.86/8°
16 — platinocyanide	$BaPt(CN)_4+4\,H_2O$	560.7	3.05
17 — silicofluoride	$BaSiF_6$	279.7	4.29/21°
18 — sulphate	$BaSO_4$	233.43	4.486—4.53
19 — sulphide	BaS	169.43	4.30
20 — sulphite	$BaSO_3$	217.43	
21 — tetrahydrogen phosphate	$BaH_4(PO_4)_2$	331.48	2.9/4°
22 — tetrasulphide	BaS_4	265.61	2.98/20°
23 Bismuth	Bi	208.0	9.76
24 — carbonate, basic	$2(BiO)_2CO_3+H_2O$	1034.0	
25 — hydroxide	$Bi(OH)_3$	259.0	
26 — iodate	$Bi(IO_3)_3$	732.8	
27 — nitrate	$Bi(NO_3)_3+5\,H_2O$	484.1	2.8
28 — — (basic)	$Bi(OH)_2NO_3$	304.0	
29 — oxychloride	$BiOCl$	259.5	7.717/15°
30 — pentoxide	Bi_2O_5	496.0	
31 — phosphate	$BiPO_4$	303.0	6.323/15°
32 — sulphate	$Bi_2(SO_4)_3$	704.2	

Crystalline form and colour	Solubility* in 100 parts water at 15°C (60°F)	100 parts water at 100°C (212°F)	Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
II. W.	3.3	101.5 (80°)	v.s.s. alc.	loses 7 aq. in air 1aq. at R.H		1
V.	30	33	i. alc.	d.		2
V.	.022	0.197	s. HNO_3, HCl	d.		3
IV.	200	300	v.s.	740		4
III., G.	i.		s. ac.			5
Am., I. Gr.	combines with H_2O		s. ac.	W.H.		6
I.	8.1	32.2	i. alc.	575		7
III. Pyr.	63/20°	v.s.	v.s. HCl, s. alc.	d. 115		8
III.	s.		s. alc.	505		9
Gr.	i.	d.	s. HCl	R.H.		10
III.	v.s.s.	d.		6 aq. : 130		11
V.	v.s.	d.				12
	i.	i.	s. ac.			13
IV. W.	s.s.	s.s.	s. ac.			14
V. P.			d. alc.			15
IV. G.	0.33	s.	s. alc.			16
	0.26	s.s.	i. alc., s.s. ac.			17
IV.	i.	i.	s.s. H_2SO_4	1500		18
IV.	d.		i. alc.	d.		19
I., prism.	i.		s. ac.			20
VI.	d.		s. ac.			21
						22
IV. P.	50		i. alk.	268	1090—1450	23
IIIa.	i.		s. HNO_3	aq 100	becomes Bi_2O_3	24
W. pdr.	i.	i.				
W.	i.		s. ac.	aq 100		25
	i.		s.s. HNO_3			26
VI.	d.		s. HNO_3	74	5 aq 80	27
VI. W.	i.		s. min. ac.	d.		28
W., cryst.	i.		s. HCl	R.H.		29
R. Br.	i.	i.	s. HCl	d. 225		30
Micro cryst	i.	i.		d.		31
W	d.			d.		32

Name.	Formula.	Formula Weight.	Density. Water=1 D:Air=1
1 Bismuth tribromide	$BiBr_3$	447.8	5.604
2 — trichloride	$BiCl_3$	314.4	4.6/11°
3 — tri-iodide	BiI_3	588.8	5.65/20°
4 — trioxide	Bi_2O_3	464.0	8.868
5 — trisulphide	Bi_2S_3	512.2	6.5 ppd.
6 Borax	$Na_2B_4O_7+10\,H_2O$	382.2	1.69
7 Boric acid	H_3BO_3	62.0	1.4347/15°
8 Borofluoric acid	HBF_4	88.0	
9 Boron	B	11.0	2.68; am. 2.45
10 — nitride	BN	25.0	
11 — tribromide	BBr_3	250.8	2.69
12 — trichloride	BCl_3	117.4	1.35/0°
13 — trifluoride	BF_3	68.0	
14 — tri-iodide	BI_3	391.8	3.3/50°
15 — trioxide	B_2O_3	70.0	1.83/4°
16 — trisulphide	B_2S_3	118.2	1.55
17 Bromic acid	$HBrO_3$	128.93	
18 Bromine	Br	79.92	3.1872
19 — monochloride	$BrCl+10\,H_2O$	295.54	
20 — mono-iodide	BrI	206.84	4.4157/0°
21 — sulphide	Br_2S_2	223.96	2.629
22 Cadmium	Cd	112.40	8.64
23 — bromide	$CdBr_2$	272.24	4.794/20°
24 — carbonate	$CdCO_3$	172.40	4.49
25 — chlorate	$Cd(ClO_3)_2+2\,H_2O$	315.35	2.284/18°
26 — chloride	$CdCl_2+2\,H_2O$	219.35	3.6/15°
27 — — anhydr.	$CdCl_2$	183.32	3.655/17°
28 — fluoride	CdF_2	150.40	5.99/22°
29 — hydroxide	$Cd(OH)_2$	146.42	4.79
30 — iodate	$Cd(IO_3)_2+H_2O$	480.25	
31 — iodide	CdI_2	366.24	4.576
32 — nitrate	$Cd(NO_3)_2+4\,H_2O$	312.48	2.45

Crystalline form and colour	Solubility* in 100 parts water at 15°C (60°F)	100 parts water at 100°C (212°F)	Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
Y., prism.	deliq., d.		s. HCl	210—215	453	1
W., cryst.	deliq., d.		s. HCl	227	429	2
Bl., cryst.	s.	d.	s. HI	subl.	<439	3
Y.W.	s.		s. alc.	ppd. 820		4
IV.	i.		s. HNO_3	d.		5
V.,+5aq.I.	6.2	201.4	i. alc.	R.H.		6
VI.	4	34	1 : 6 alc.	185, aq. 100, liq.		7
	s.	s.			d. 190	8
V., Y.;	i.	i..	i. alc.	2200—2500		9
Am., W.	i.	i.	d. HF			10
	d.			liq.	90.5	11
C.	d			liq.	18.2	12
	1000 vol. in 1	d.	d. in alc.	-127	-101	13
C. cryst.	d.		s. CS_2 and C_6H_6	43	210	14
C.	d.		s. alc.	<1500		15
W.	d.		d., s. PCl_3	310		16
C.	s.	s.			d. 100	17
Br.	3.5		s. alc.	-7.3	63	18
Y.	v.s.			an. 7		19
	d.		s. CS_2 and $CHCl_3$	36		20
R.	d.			liq.	190—200	21
III.	i.	i.	s. HNO_3, HCl	320.9	778	22
W.	deliq.	49	s. HCl, s. alc.	580	863	23
W.	i.	i.	s. ac.			24
Prism.	deliq.	v.s.	s. alc.	d. 80		25
Cryst.	140	150	s. alc.	590	900	26
	140.8	150	s. alc.	560	964	27
	s.s.	s.s.	s. HF., i. alc.	520		28
W.	i.	i.	s. ac.	aq 300		29
V., small cryst.	s.s.	s.s.	s. HNO_3	d.		30
Cryst.	89	132	s. alc., ether	350	716	31
	127	v.s.	s. alc.	59.5	132	32

Name	Formula.	Formula Weight.	Density. Water=1 D:Air=1
1 Cadmium oxide	CdO	128.40	6.95
2 —sulphate	(a) 3 $CdSO_4+8\ H_2O$	769.51	
	(b) $CdSO_4+4\ H_2O$	284.52	3.05
3 — sulphide	CdS	144.50	4.58 ppd.
4 Cæsium carbonate	Cs_2CO_3	325.62	
5 — chloride	CsCl	168.27	3.972/20°
6 — hydroxide	CsOH	149.82	4.018/4°
7 — nitrate	$CsNO_3$	194.82	3.687/28°
8 — platinichloride	Cs_2PtCl_6	673.6	
9 — silicofluoride	Cs_2SiF_6	407.9	3.375/17°
10 — sulphate	Cs_2SO_4	361.68	4.250/16°
11 Calcium	Ca	40.07	1.554/18°
12 — arsenate	$Ca_3(AsO_4)_2$	398.13	
13 — bromide	$CaBr_2(+6\ H_2O)$	199.91	3.32/20°
14 — carbide	CaC_2	64.08	2.22/18°
15 — carbonate	$CaCO_3$	100.08	2.72—2.9
16 — chlorate	$Ca(ClO_3)_2(+2\ H_2O)$	206.99	
17 — chloride	$CaCl_2+6\ H_2O$	219.09	1.6775/17°
18 —— anhydr.	$CaCl_2$	110.99	2.26/20°
19 — chromate	$CaCrO_4+2\ H_2O$	192.1	
20 — cyanide	$Ca(CN)_2$	92.10	
21 — cyanamide	$CaCN_2$	80.09	
22 — ferrocyanide	$Ca_2Fe(CN)_6+12\ H_2O$	508.31	
23 — fluoride	CaF_2	78.07	3.18
24 — hydrogen phosphate	$CaHPO_4+2\ H_2O$	172.15	2.3
25 — hydrosulphide	$Ca(HS)_2(+6\ H_2O)$	106.21	
26 — hydroxide	$Ca(OH)_2$	74.09	2.078 am.
27 — hypochlorite	$Ca(OCl)_2+4\ H_2O$	215.05	
28 — hypophosphite	$Ca(H_2PO_2)_2$	170.18	
29 — iodate	$Ca(IO_3)_2(+6\ H_2O)$	389.91	
30 — iodide	$CaI_2(+6\ H_2O)$	293.91	4.9/20° an.

Crystalline form and colour	Solubility* in 100 parts water at 15°C (60°F)	100 parts water at 100°C (212°F)	Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
I., Br., R.	i.	i.				1
V.	59	v.s.		an.		2
	95	v.s.	i. alc.	1000		
III. Y.	i.	i.	s. conc. ac.	W.H.		3
	deliq.	v.s.	s. alc. 11.1/19°	<R.H.	d. 610	4
I. C.	174	v.s.	s. alc.	631	subl.	5
	deliq.	v.s.	s. alc.			6
II.	10.58/3.2°		s.s. alc.	414	d.	7
I. Y.		v.s.s.				8
I.	6	s.	i. alc.			9
C.	158.7/–2°	v.s.	i. alc.			10
IIIa. Y.	d.		d.	805		11
	i.	i.				12
W. needles	140	310	v.s. alc.	760	800	13
Gr. Y. cryst.	gives C_2H_2		not d. conc. H_2SO_4			14
IIIa, IV.	0.0018	0.088	CO_2 with acids	d. 825		15
V.	deliq.	v.s.	v.s. alc., s. acet.	d.		16
III.	400	650	alc. 13	29	4 aq 30 in vacuo 6 aq 200	17
Am. W.	66	155		780		18
Y. cryst.	0.4	s.		2 aq R.H.		19
I.	s.	s.				20
		s. d.		d.		21
Y. prism.	(+12 aq) <150	150 (90°)		d.		22
I.	0.05	v.s.s.		1330		23
V. W.	s.s.	d.	s. amm. citrate	an. 100		24
Cryst. –	v.s.		s. alc.		d.	25
W. needles	0.137	0.075	i. alc.			26
	deliq. & s.			d.		27
V.	17	slightly >17	i. alc.	d. R.H.		28
IV.	0.4	1.33	s. HNO_3	d.		29
W. plates.	201	435/92°	s. acetone	740		30

Name.	Formula.	Formula Weight.	Density. Water=1 D:Air=1
1 Calcium nitrate	$Ca(NO_3)_2+4\ H_2O$	236.15	1.878/18°
2 — nitride	Ca_3N_2	148.23	2.63/17°
3 — nitrite	$Ca(NO_2)_2(+H_2O)$	132.09	
4 — oxide	CaO	56.07	3.08
5 — peroxide	$CaO_2+8\ H_2O$	216.20	
6 — phosphate, ortho-	$Ca_3(PO_4)_2$	310.29	3.18
7 — — meta-	$Ca(PO_3)_2$	198.15	
8 — — pyro-	$Ca_2P_2O_7(+4\ H_2O)$	254.22	
9 — phosphide	Ca_3P_2	182.29	2.51/15°
10 — plumbate	Ca_2PbO_4	351.34	
11 — plumbite	$CaPbO_2$	279.27	
12 — potassium sulphate	$CaSO_4K_2SO_4+H_2O$	328.41	2.6/17°
13 — sodium sulphate	$CaSO_4\ 2\ Na_2SO_4+2\ H_2O$	456.28	
14 — sulphate (gypsum)	$CaSO_4+2\ H_2O$	182.16	2.306/15°
15 — sulphide	CaS	72.13	2.8
16 — sulphite	$CaSO_3+2\ H_2O$	156.17	
17 — tetrahydrogen orthophosphate	$CaH_4(PO_4)_2+H_2O$	252.20	2/4°
18 — thiosulphate	$CaS_2O_3+6\ H_2O$	260.29	1.87
19 Carbon (diamond)	C	12.00	3.48—3.53
20 — (graphite)	C	12.00	2.14—2.27
21 — dioxide	CO_2	44.00	liq. 0.83; solid. 1.2
22 — disulphide	CS_2	76.12	D.2.68; 1.292
23 — monoxide	CO	28.00	liq. 0.7929
24 — oxysulphide	COS	60.06	
25 — tetrachloride	CCl_4	153.84	1.582/21°
26 Carbonyl chloride (phosgene)	$COCl_2$	98.92	1.432/0° 1.392/18.6°
27 Ceric sulphate	$Ce\ (SO_4)_2$	332.37	
28 Cerium	Ce	140.25	6.6—7.0
29 — dioxide	CeO_2	172.25	6.74
30 — sesquioxide	Ce_2O_3	328.50	6.9—7.0

Crystalline form and colour	Solubility* in 100 parts water at 15°C (60°F)	100 parts water at 100°C (212°F)	Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
V.	54.8	v.s.	s. alc.	44, an. 561	d. 132	1
Br.	d.			900		2
III., prism	v.s.	v.s.	s.s. alc.	aq 100		3
O., I.	d.		s. alc.			4
II.	s.s.		i. alc.	8 aq 130	d.	5
W.	i.	i.	s. ac.	fusible		6
W.	i.	i.	i ac.			7
W.	i.		s. ac.			8
Cryst.	yields pure PH_3			burns in O at 300		9
Br., cryst.	i.	d.	d. ac.	d.		10
Cryst.		s.s.		d.		11
V.	s.s.	d.	i. alc.			12
V.		d.		2 aq 80		13
V. W.	0.24 (0°)	0.22	i. alc.	2 aq 130		14
I. W.	d.				d.	15
W. needles	0.125		s. SO_2 soln	2 aq 100		16
IV.	0.128	0.079	s. acids	aq 100	d. 200	17
VI.	100 (3°)	d.		d.		18
I., C.	i.	i.	i			19
III., Gr.	i.	i.	i			20
	1.797 in 1 vol. (0°)		alc. 1 : 3.2 vol. (15°)	−65	−78.2	21
	2 : 1000/0° 30 vol.	1.4 : 10000/ 50°	m. alc.	−116	46	22
			sol. in am. or acid Cu_2Cl_2	−207/100 mm.	−190	23
gas.	1 : 1 vol.			d.	0° at 12 atm.	24
	i.			−23.8	76.7	25
	d.		d. alc.	gas	8	26
Y. cryst. pdr.	forms basic salt					27
Gr. met.	d.		s. HCl, HNO_3	623		28
W. pdr.	i.	i.	s. H_2SO_4			29
G. pdr.			s. H_2SO_4, i. HCl			30

Name.	Formula.	Formula Weight.	Density. Water=1 D:Air=1
1 Cerous carbonate	$Ce_2(CO_3)_3+5\ H_2O$	550.59	
2 — chloride	$CeCl_3$	246.63	3.88/15.5°
3 — phosphate	$CePO_4$	235.29	5.92/14°
4 — sulphate	$Ce_2(SO_4)_3$	568.68	3.91
5 Chlorauric acid	$HAuCl_4+4\ H_2O$	412.1	
6 Chloric acid	$HClO_3(+7\ H_2O)$	84.47	1.282
7 Chlorine	Cl	35.46	liq. :1.33/14°; D :2.4502/200°
8 — dioxide	ClO_2	67.46	1.5; D :2.39
9 — heptoxide	Cl_2O_7	182.92	
10 — hydrate	$Cl_2+8\ H_2O$	215.05	1.2
11 — monoxide	Cl_2O	86.92	liq. 3.87
12 Chlorplatinic acid	H_2PtCl_6	410.0	2.431
13 Chlorsulphonic acid	$ClSO_2OH$	116.53	1.72/18°
14 Chromic acid	H_2CrO_4	118.0	
15 — bromide	Cr_2Br_6	583.5	
16 — chloride	Cr_2Cl_6	317.8	D :5.51/1277°; 2.76/15°
17 — fluoride	Cr_2F_6	218.0	3.78
18 — hydroxide	$Cr_2(OH)_6+4\ H_2O$	278.1	
19 — nitrate	$Cr(NO_3)_3+9\ H_2O$	400.17	
20 — sulphate	$Cr_2(SO_4)_3+18\ H_2O$	716.5	1.867/15°
21 — sulphide	Cr_2S_3	200.2	3.77
22 Chromium	Cr	52.0	6.92/20°
23 — sesquioxide	Cr_2O_3	152.0	5.21 cryst.
24 — trioxide	CrO_3	100.0	2.74 cryst.
25 Chromous chloride	$CrCl_2$	122.9	2.75/14°
26 Chromyl chloride	CrO_2Cl_2	154.9	1.96
27 Cobalt	Co	58.97	8.951
28 Cobaltic chloride	CO_2Cl_6	330.70	2.94
29 — —, luteo	$Co_2(NH_3)_{12}Cl_6$	535.08	1.7/20°
30 — —, praseo	$Co_2(NH_3)_8Cl_6+2\ H_2O$	503.00	
31 — —, purpureo	$Co_2(NH_3)_{10}Cl_6$	501.00	1.802/23°
32 — —, roseo	$Co_2(NH_3)_{10}Cl_6+2\ H_2O$	537.0	
33 — —, xantho	$Co_2(NH_3)_{10}(NO_2)_2Cl_4$	522.10	
34 Cobalticyanic acid	$(H_3CO(CN)_6)_2+H_2O$	454.18	

Crystalline form and colour	Solubility* in 100 parts water at 15°C (60°F)	100 parts water at 100°C (212°F)	Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
Plates	i.		s. $(NH_4)_2CO_3$			1
C.	s.		s. alc.	fusible	d.	2
V. R.	i.	i.	i. ac.			3
G. pdr.	40/0°	0.775				4
Y. needles	s.	v.s.	s. alc.	d.		5
	s.			d.	d.	6
G.	1 :2.6 vol.	1 :1.4, 40°		−102	−33.5	7
R.	20 vol. :1		alk. d.	−76	10/731 mm.	8
C.	d.		s. C_6H_6		82	9
I. Y.	s.		s. HCl	d. 9.6		10
Y. R.	s.			expl.	19	11
R. cryst.	deliq.	v.s.				12
C.	d.		d.	liq.	158	13
R. cryst.	s.	v.s.		gives CrO_2		14
dark.	i.	s.	alk. d.		subl.	15
P.	i.	i.	i. alc.		1300	16
G.	i.			>1000	subl.	17
B.	i.	i.	s. ac., alk.	3 aq in vac		18
			s. $NaHSO_3$	4 aq 100		
Viol. prism	s.	v.s.	s. alk.	36.5		19
I., Viol.	120	s. green 90°	s. alc.	4 aq 100	an. 400	20
R.			s. HNO_3			21
IIIa, G.	i.	i.	s. HCl, i. HNO_3	1505		22
III., G.	i.	i.	i. alc.	W. H.		23
IV., R.	v.s.	v.s.	alc. d.	190	d.	24
W.	s.	s.		fusible		25
R.	d.		alc. d.	liq.	116	26
Gr. met.	i.	i.	s. ac.	1490		27
	s.	s.	s. alc.	d.		28
V. R. Y.	1 :16.8	v.s.	s. conc. HCl	d.		29
G. cryst.	v.s.			d.		30
	1 :255	s.	s. conc. H_2SO_4	d.		31
R. cryst.	1 :4.8	d.	i. alc.	d. 100		32
Y. cryst.	s.s.	s. d.				33
C. needles	deliq.		s. alc.	d. <100		34

Name.	Formula.	Formula Weight.	Density. Water=1 D:Air=1
1 Cobaltic hydroxide	$Co_2(OH)_6$	219.99	
2 — oxide	Co_2O_3	165.94	5.1
3 Cobalto-cobaltic oxide	Co_3O_4	240.91	5.8—6.3
4 Cobalt arsenate	$Co_3(AsO_4)_2+8\,H_2O$	598.96	2.948
5 — bromide	$CoBr_2+6\,H_2O$	326.91	
6 — carbonate	$CoCO_3$	118.97	
7 — chlorate	$Co(ClO_3)_2+6\,H_2O$	333.99	
8 — chloride	$CoCl_2+6\,H_2O$	237.99	1.84
9 — —, anhydr.	$CoCl_2$	129.89	2.94
10 — cyanide	$Co(CN)_2+3\,H_2O$	165.05	
11 — hydroxide	$Co(OH)_2$	92.99	3.597/15°
12 — nitrate	$Co(NO_3)_2+6\,H_2O$	291.09	1.83
13 — phosphate	$Co_3(PO_4)_2+8\,H_2O$	511.12	
14 — oxide	CoO	74.97	5.68
15 — silicate	Co_2SiO_4	210.2	4.63
16 — sulphate	$CoSO_4+7\,H_2O$	281.14	1.96/15°
17 — sulphide	CoS	91.03	
18 — tetracarbonyl	$Co_2(CO)_8$	341.98	
19 — tricarbonyl	$Co(CO)_3$	142.99	
20 Columbium	Cb	93.1	8.4
21 — dioxide	Cb_2O_2	218.2	6.3
22 — hydride	CbH	94.1	6.6
23 — oxychloride	$CbOCl_3$	215.5	D:7.88/400°
24 — pentachloride	$CbCl_5$	270.4	D:9.6/360°; 4.4—4.5
25 — pentoxide	Cb_2O_5	266.2	4.53—4.57
26 Copper	Cu	63.57	8.94/20°
27 — carbonate, basic (malachite)	$CuCO_3+Cu(OH)_2$	221.16	3.65—4.05
28 — — — (azurite)	$2CuCO_3+Cu(OH)_2$	344.73	3.88
29 — dioxide	CuO_2+H_2O	113.59	
30 Cuprammonium sulphate	$CuSO_4+4NH_3+H_2O$	245.80	

Crystalline form and colour	Solubility* in 100 parts water at 15°C (60°F)	100 parts water at 100°C (212°F)	Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
Bl.	i.	i.	i. alc., d. HCl		6 aq 100	1
Br.	i.	i.	i. alc., s. ac.	d. R.H.		2
I., Bl.	i.	i.	s. conc. H_2SO_4			3
V., Viol.	i.	i.	s. HCl	d.		4
R. prism.	s.	v.s.	s. alc., ether	4 aq 100, 2 aq 130	an. 130	5
IIIa, R.	i.	i.	alc.	d.		6
I.	deliq.		s. alc.	50	d. 100	7
V., R.	s.	s.	s. alc.	86.75	6 aq 110	8
B.	50	108	s. alc.	subl. in Cl		9
Am. R.	i.		s. KCN	3 aq 250		10
P. cryst.	i.	i.	s. NH_4OH			11
P. cryst.	deliq.	v.s.	alc. 200	d. R.H.		12
	i.	i.	i. alc.	d.		13
Br.	i.	i.	i. alc.	d. 100		14
Viol.	i.		d. HCl			15
IV., R.	32.0	82.6	i. alc.			16
Gr., Pr.	i.	i.	s. acids			17
Or. cryst.	i.		s. alc. CS_2	51	d. 60	18
Bl. cryst.	s.s.		d. with Br			19
Gr.			s. conc. H_2SO_4	1950		20
I. Bl.	i.	i.	s. HCl			21
Gr., pdr.			s. HF, conc. H_2SO_4	ignites		22
W.	d.		s. KOH, alc.		subl. 400	23
Y. needles	d.		s. HCl, CCl_4	194	240.5	24
Am. W., cryst. G.	i.	i.	s. H_2SO_4	infusible		25
I., R.	i.	i.	s. ac.	1083.0		26
V. G.	i.	i.	s. NH_4OH	d.		27
V. B.	i.	i.		d.		28
Y.Br.	i.		i. alc.	aq d. 6	an. d. 180	29
IV. B.	60	d.	i. alc.	d. 150		30

Name.	Formula.	Formula Weight.	Density. Water=1 D:Air=1
1 Cupric arsenite	$CuHAsO_3$	187.54	
2 — bromide	$CuBr_2$	223.41	
3 — chlorate	$Cu(ClO_3)_2+6H_2O$	338.59	
4 — chloride	$CuCl_2+2H_2O$	170.52	2.47
5 — hydroxide	$Cu(OH)_2$	97.59	3.368
6 — nitrate	$Cu(NO_3)_2+6H_2O$	295.69	2.047
7 — oxide	CuO	79.57	6.304
8 — oxychloride	Cu_2OCl_2	214.06	
9 — phosphate	$Cu_3(PO_4)_2+3H_2O$	434.84	
10 — sulphate	$CuSO_4+5H_2O$	249.71	2.274/15°
11 — sulphide	CuS	95.63	4.59
12 Cuprous acetylide	$Cu_2C_2.H_2O$	169.17	
13 — bromide	Cu_2Br_2	286.98	4.72
14 — chloride	Cu_2Cl_2	198.06	D. 6.6/1690°; 3.7
15 — cyanide	$Cu_2(CN)_2$	179.17	
16 — hydride	Cu_2H_2	129.16	
17 — hydroxide	$4Cu_2O+H_2O$	590.58	
18 — iodide	Cu_2I_2	380.98	5.67
19 — oxide	Cu_2O	143.14	5.8—6.1
20 — sulphate	Cu_2SO_4	223.20	
21 — sulphide	Cu_2S	159.20	5.58 artif.
22 — sulphite	$Cu_2SO_3+H_2O$	225.22	4.46
23 Disulphuryl chloride	$S_2O_5Cl_2$	215.04	1.819/20° D. 7.4
24 Ferric arsenate	$FeAsO_4+2H_2O$	230.83	3.18
25 — arsenite	$4Fe_2O_3+As_2O_3+5H_2O$	926.72	
26 — bromide	Fe_2Br_6	591.20	
27 — chloride	Fe_2Cl_6	324.44	D:11.2/320°; 2.8/11°
28 — ferrocyanide (Insoluble Prussian blue or Turnbull's blue)	$Fe_4(FeC_6N_6)_3$	859.15	
29 — hydroxide	$Fe_2(OH)_6$	213.73	3.4—3.9

Crystalline form and colour	Solubility* in 100 parts water at 15°C(60°F)	100 parts water at 100°C(212°F)	Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
G.	i.		s. alc.	d.		1
B.	deliq.			d.		2
G.	v.s.	v.s.	s. alc.	65	d.	3
IV., B.	121	v.s.	s. alc.	100	d. R.H.	4
B.	i.		s. NH_4OH	d.		5
B. cryst.	v.s.	v.s.	v.s.	38	d.	6
I. & V., Bl.	i.	i.	i. alc.			7
Y.	d.			d.		8
IV., B.	s.s.	d.	s. H_3PO_4			9
VI., B.	40	203	i. alc.	4 aq 100, 5 aq 240	d. R.H.	10
III., Bl.	i.	i.	i. alc.	d.		11
Am. R.			with ac. : C_2H_2	expl.		12
Br. B.	i.		s. NH_4OH	504	861—894	13
I. W.	v.s.s		s.HCl, NH_4OH	410	abt. 1000	14
W.			s. HCl, H_2SO_4	R. H.	d.	15
	d.		d. HCl	d. 60		16
Y.	i.		s. NH_4OH	d. 360		17
W. cryst.	i.	i.	s. NH_4OH	628		18
I., R.	i.	i.	s. NH_4OH	fusible		19
Gr. pdr.	d.			oxidises at 200		20
IV., Bl.	i.	i.	i. alc.	1091		21
III., R.	s.s.			d.		22
	d.			−39	146	23
IV., W.	i.	i.		d.		24
Br.	v.s.s		s. HCl	d.		25
R. cryst.	deliq.	s.	s. alc.	d.	subl. & d.	26
III.,Br.,Bl	158	537	s. alc.	301	280—285	27
Am. B.	i.	i.	s. oxalic acid	d.		28
R., Br.	i.	i.	i. alc., s. ac.	d.		29

Name.	Formula.	Formula Weight.	Density. Water=1 D:Air=1
1 Ferric nitrate	$Fe_2(NO_3)_6+18\,H_2O$	808.10	1.6835
2 — oxide	Fe_2O_3	159.68	5.2—5.3
3 — phosphate	$Fe(PO_4)+2\,H_2O$	186.91	2.87
4 — potassium ferro-cyanide (Soluble Prussian blues)	$KFe(FeC_6N_6)$	306.87	
5 — sulphate	$Fe_2(SO_4)_3+9\,H_2O$	562.00	2—2.1
6 — sulphide	Fe_2S_3	207.86	4.4
7 — thiocyanate	$Fe_2(CNS)_6+6\,H_2O$	568.23	
8 Ferricyanic acid	$H_3FeC_6N_6$	214.95	
9 Ferrocyanic acid	$H_4Fe(CN)_6$	213.92	
10 Ferropentacarbonyl	$Fe(CO)_5$	195.86	1.46; D 6.5
11 Ferroso-ferric oxide	Fe_3O_4	231.52	5.18 cryst.
12 Ferrotetracarbonyl	$Fe(CO)_4$	167.86	1.996/18°
13 Ferrous ammonium sulphate	$FeSO_4(NH_4)_2SO_4+6\,H_2O$	392.14	1.813
14 — arsenate	$Fe_3(AsO_4)_2+6\,H_2O$	553.54	
15 — bromide	$FeBr_2+6\,H_2O$	323.78	
16 — carbonate	$FeCO_3$	115.84	3.7—3.9
17 — chloride	$FeCl_2+4\,H_2O$	198.82	an. 2.528; 1.926
18 — fluoride	$FeF_2+8\,H_2O$	237.97	
19 — hydroxide	$Fe(OH)_2$	89.86	
20 — iodide	$FeI_2+4\,H_2O$	381.74	2.873
21 — nitrate	$Fe(NO_3)_2+6\,H_2O$	287.96	
22 — oxide	FeO	71.84	
23 — perchlorate	$Fe(ClO_4)_2+6\,H_2O$	362.86	
24 — phosphate	$Fe_3(PO_4)_2+8\,H_2O$	501.73	2.58—2.68
25 — platinichloride	$FePtCl_6$	463.8	2.714
26 — sulphate	$FeSO_4+7\,H_2O$	278.01	1.889
27 — sulphide	FeS	87.90	4.84
28 — thiocyanate	$Fe(CNS)_2+3\,H_2O$	226.04	

Crystalline form and colour	Solubility* in 100 parts water at 15°C (60°F)	100 parts water at 100°C (212°F)	Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
V; +12 aq. I.	s.	s.	s. alc.	47.2	d.	1
IIIá, Gr.	i.	i.	s. ac.			2
Y.	i.	i.	i.c. acetic	d.		3
B.	i.		d. alk. and oxalic	d.		4
IV.	deliq.	d.	d. alc.	d.		5
Y.	i.	i.	d. ac.	d.		6
I., R., or Bl.	red s.	v.s.	s. alc., ether	d.		7
Needles, Gr. Br.	deliq.	s.	s. alc.	d.		8
W. needles	s.		s. alc., i. ether	d.		9
Y.	d.		s. H_2SO_4, alc.	−21	103	10
I., Bl.	i.	i.	i. alc.			11
G. plates			s. org. solv.	d. 140—150		12
V.	19	78/75°	i. alc.	d.		13
W.	i.		s.s. NH_4OH	d.		14
IV., B., G.	s.	56.7/75°	s. alc.	d.		15
IIIa	i.	i.	s. CO_2 soln.	d.		16
V., C.	deliq.	v.s.	s. alc.	R.H.		17
G.B.	s.	s.	s. HF	8 aq 100		18
W.	v.s.s.		s. ac.	d.		19
Gr. cryst.	v.s.	d.	s. alc.	177		20
	s.	d.		d.		21
Bl.	i.	i.	i. alc.	oxidises		22
G.	s.s.			d. >100		23
V., B.	i.	i.	i. ac.			24
III., Y.	v.s.	v.s.		d.		25
IV.; V.; +5 aq. VI; +4 aq. II.	20.4	42.6	i. alc.	6 aq 100 7 aq 280	d. R.H.	26
Bl.	i.	i.	s. ac.	R.H.		27
IV., G.	s.		s. alc.	d.		28

Name.	Formula.	Formula Weight.	Density. Water=1 D:Air=1
1 Fluorine	F	19.0	
2 Gallium	Ga	69.9	5.935—5.956
3 — dichloride	$GaCl_2$	140.82	D:4.8/1000°
4 — sulphate	$Ga_2(SO_4)_3$	427.98	
5 — trichloride	Ga_2Cl_6	352.6	D: 6.1/400—606°
6 Germanium	Ge	72.5	5.469/20.4°
7 — chloroform	$GeHCl_3$	179.9	
8 — dioxide	GeO_2	104.5	4.703/18°
9 — disulphide	GeS_2	136.6	
10 — monosulphide	GeS	104.6	D:3.54/1100°
11 — tetrachloride	$GeCl_4$	214.3	1.887/18°
12 — tetra-iodide	GeI_4	580.2	D:20.5/440°
13 Glucinum	Gl	9.1	2.1
14 — bromide	$GlBr_2$	168.9	
15 — chloride	$GlCl_2(+4\,H_2O)$	80.0	
16 — iodide	GlI_2	262.9	
17 — nitrate	$Gl(NO_3)_2+3\,H_2O$	187.2	
18 — oxide	GlO	25.1	3.02
19 — sulphate	$GlSO_4+4\,H_2O$	177.2	1.725/10°
20 Gold	Au	197.2	19.26—19.55
21 Helium	He	3.99	
22 Hydrazine	$H_2N{\cdot}NH_2$	32.05	1.013/15°
23 — di-hydrochloride	$N_2H_4{\cdot}2HCl$	104.99	1.4226/20°
24 — hydrate	$H_2N{\cdot}NH_3(OH)$	50.07	1.0305/21°
25 Hydriodic acid	HI	127.93	4.375
26 — — hydrate	$HI+xH_2O$ (57%)		1.69
27 Hydrobromic acid	HBr	80.93	1.78
28 — — hydrate	$HBr+H_2O$ (47.8%)		1.49
29 Hydrochloric acid	HCl	36.47	0.929/8°
30 — — hydrate	$HCl+H_2O$ (45.2%)		1.2257
31 — — —	$HCl+8\,H_2O$ (20.18%)		1.101
32 Hydrocyanic acid	HCN	27.03	0.6967/18°

Crystalline form and colour	Solubility* in 100 parts water at 15°C (60°F)	100 parts water at 100°C (212°F)	Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
Y.G.	d.			−233	−187	1
I., W.	i.	i.	s. alk., HCl	30.1		2
W. cryst.	d.			164	535	3
W.	v.s.		s. alc.			4
W. needles	deliq., d.			75.5	220	5
I., Gr.	i.	i.	s. aq. regia	960	>1350	6
C.	i.	i.		liq.	75	7
W. pdr.	0.4	7.0	s. ac.	d.		8
W. pdr.	0.45		s. KOH			9
IV. or V.	i.	i.	s. KOH, s.s. HCl	R.H.		10
	slow d.			liq.	86	11
P. pdr.	deliq.	d.		144	350—360	12
W.	i.	i.	s. HCl, alk	>1000		13
W. needles	s.		s. alc.	601	subl.	14
C. cryst.	deliq.	v.s.	s. alc.	600	subl.	15
W. needles	s.			510	590	16
Cryst.	deliq.			60	d. 200	17
O., W.	i.		s. alc.			18
II.; +7 aq., V.	100/15°			2 aq 100	d. R.H.	19
I.			s. aq. regia	1061.0	dist.	20
	0.015			<−253	−268	21
Cryst.	s.			1.4	113	22
I.	s.	s.		198		23
C.	m.	v.s.	m. alc.	<−40	118.5/740	24
	v.s.	s.	s. alc.	−53	−36.7/752	25
	m.	m.	m. alc.		127	26
	221	130	s. alc.	−86	−68.7	27
	m.	m.	s. alc.	−11	126	28
	82.5/0°	56/60°	327 vol. in alc.	−112.5	−83.1/755	29
	m.		s. alc.			30
	m.		s. alc.		110	31
	m.	m.	m. alc.	−13.8	26.1	32

Name.	Formula.	Formula Weight.	Density. Water=1 D:Air=1
1 Hydrofluoric acid	HF	20.0	0.9879/15°
2 — — hydrate	HF (35.35%)		1.15
3 Hydrofluosilicic acid	H_2SiF_6	144.3	
4 Hydrogen	H	1.008	0.0763/–260°
5 — disulphide	H_2S_2	66.13	1.71
6 — peroxide	H_2O_2	34.016	1.458/0°
7 — selenide	H_2Se	81.2	
8 — sulphide	H_2S	34.08	liq. 0.91/18.5°
9 Hydroxylamine	NH_2OH	33.04	1.227/14°
10 — hydrochloride	$NH_2OH{\cdot}HCl$	69.50	1.676/17°
11 — nitrate	$NH_2OH{\cdot}HNO_3$	96.05	
12 — sulphate	$(NH_2OH)_2.H_2SO_4$	164.16	
13 Hypobromous acid	$HBrO$	96.93	
14 Hypochlorous acid	$HClO$	52.47	
15 Hypophosphorous acid	H_3PO_2	66.06	1.49/10°
16 Indium	In	114.8	7.42
17 — chloride	$InCl_3$	221.2	
18 — oxide	In_2O_3	277.6	7.18
19 — sulphide	In_2S_3	325.8	
20 Iodic acid	HIO_3	175.93	4.629/0°
21 Iodine	I	126.92	4.933
22 — monochloride	ICl	162.38	3.222; D:80.3/120°
23 — pentoxide	I_2O_5	333.84	4.487/0°
24 — trichloride	ICl_3	233.30	3.11
25 Iridium	Ir	193.1	21.15/17.5°
26 — sesquioxide	Ir_2O_3	434.2	
27 — tetrabromide	$IrBr_4$	512.8	
28 — tetrachloride	$IrCl_4$	334.9	
29 — tetra-iodide	IrI_4	700.8	
30 — trichloride	Ir_2Cl_6	599.0	
31 Iron, cast-iron	Fe	55.84	7—7.6
32 —, wrought-iron			7.25—7.79
33 —, steel			7.6—7.8

Crystalline form and colour	Solubility* in 100 parts water at 15°C (60°F)	100 parts water at 100°C (212°F)	Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
	111/35°	v.s.		−92.3	19.4	1
	v.s.	v.s.			120	2
C.	s.		s.s. alk.		d.	3
	1.93 vol.		alc. 6.925/0°	−257	−253	4
	i.		i	liq.	d.	5
C.	m.		s. ether	−2	84/68 mm.	6
	v.s.		s. $COCl_2$	−64	−42	7
	1 :3.23 vol. at 15°	1 :1.86 vol. at 40°	alc. 9.54/15°	−86	−61.6	8
W. needles	deliq.	d.	i. ether	33	70/60 mm.	9
V.	s.		s.s. alc.	151	d.	10
W.	v.s.	d.	v.s. alc.	−10	d. <100	11
V.	s.	s.	s.s. alc.	140	d.	12
C.	s.	s.			40 in vac.	13
Y.	100 vol./0°	s.	d. HCl		d.	14
	deliq.	v.s.		17.4	d.	15
W.	i.	i.	s. HNO_3	176		16
W.	deliq.				440	17
Y.						18
Br.						19
W.	187	v.s.		½ aq 170		20
Bl.	v.s.s.	v.s.s.	s. alc.	114	184	21
R.	slight d.		s. HCl	25	d. 101	22
W.	s.	s.		d. 300		23
Y. cryst.	s. d.		s. acetic	101/16atm	d. 25	24
Gr.	i.		i.	2300 ?		25
Bl.	i.			d. 1000		26
B.	s.		s. alc.	d.		27
Bl.	s.	s.d.	s. alc.	d.		28
Bl.	i.	i.	i. ac., s. KI	d. 360		29
Y.G.	i.		i.			30
				1050		31
Gr.	i.	i.	s. ac.	1545		32
				1300		33

Name.	Formula.	Formula Weight.	Density. Water=1 D:Air=1
1 Iron carbide	Fe_3C	179.53	
2 — disulphide	FeS_2	119.96	5.185; mineral 4.68—4.85
3 — oxide, magnetic	Fe_3O_4	231.52	5.18
4 — phosphide	FeP	142.76	6.57
5 Lanthanum chloride	$LaCl_3$	245.4	3.95/18°
6 — oxide	La_2O_3	326.0	6.48
7 — sulphate	$La_2(SO_4)_3+9\,H_2O$	728.3	
8 Lead	Pb	207.2	11.35—11.387
9 — borate	$Pb(BO_2)_2+H_2O$	311.2	5.598 an.
10 — bromide	$PbBr_2$	367.0	6.611
11 — carbonate	$PbCO_3$	267.2	6.465
12 — — (white lead)	$2PbCO_3\cdot Pb(OH)_2$	775.6	
13 — chlorate	$Pb(ClO_3)_2$	374.1	4.037
14 — chloride	$PbCl_2$	278.1	5.8
15 — chlorite	$Pb(ClO_2)_2$	342.1	
16 — chromate	$PbCrO_4$	323.2	6.123/15°
17 — cyanate	$Pb(CNO)_2$	291.2	
18 — cyanide	$Pb(CN)_2$	259.2	
19 — dioxide	PbO_2	239.2	8.9—9.39—9.54
20 — fluoride	PbF_2	245.2	8.241
21 — hydroxide	(*a*) $Pb(OH)_2$	241.2	
22 — —	(*b*) $3PbO\cdot H_2O$	687.6	
23 — iodide	PbI_2	461.0	6.12
24 — monoxide (massicot)	PbO	223.2	9.29
25 — — (litharge)	PbO	223.2	8.74—9.0
26 — — (amorph.)	PbO	223.2	9.2—9.5
27 — nitrate	$Pb(NO_3)_2$	331.2	4.53/20°
28 — oxychloride	$PbCl_2\cdot PbO$	501.3	7.21
29 — —	$PbCl_2\cdot 2PbO$	724.5	7.08
30 — phosphate, ortho	$Pb_3(PO_4)_2$	811.7	6.9—7.3
31 — — pyro	$Pb_2P_2O_7$	588.5	5.8
32 — sesquioxide	Pb_2O_3	462.4	
33 — suboxide	Pb_2O	430.4	
34 — sulphate	$PbSO_4$	303.3	6.2—6.38
35 — — (acid)	$PbH_2(SO_4)_2+H_2O$	419.4	

Crystalline form and colour	Solubility* in 100 parts water at 15°C (60°F)	100 parts water at 100°C (212°F)	Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
Bl.	i.	i.	i. dil. ac.			1
Y.	i.	i.	s. HNO_3 ppts. S.	d.		2
I., Bl.	i.	i.	i. alc., s. HCl			3
G.	i.	i.	s. ac. and d.	infusible		4
Cryst.	v.s.	v.s.	v.s. alc.	907		5
W. pdr.	gives $La(OH)_3$					6
C. cryst.	17 (3°)	0.85	s.s. HCl	d.		7
I., Gr.W.	i.		s. HNO_3	327.4	1470	8
W., pdr.	i.	i.	i. alc.	R.H.	aq 160	9
C. needles	s.s.	s.	i. alc.	d. 448		10
IV. W.	0.00198	i.	i. alc., s. ac.	d.		11
Am. W.	i.			d.		12
V., W.	s.	s.		d. 230		13
IV.	0.909	3.2	s. alk.	447	900	14
V., Y.	s.s.	s.		expl. > 100		15
V., Y.	i.	i.	s. alk., s.s. ac.	fusible		16
W. needles	s.s.	s.		d.		17
W.	i.		i. KCN soln.			18
III., Br.	i.	i.	i. alc.	d.		19
W.	i.	i.	s. HCl, HNO_3	fusible		20
W.	v.s.s.	v.s.s.	s. alk.	d. 145		21
I., W.				aq 130		22
Y., cryst.	0.081	0.515	i. alc., s. KI	375	861—954	23
IV., Y.	i.	i.	s. alk.	R.H.		24
III., R.	i.	i.				25
Am. Y.				R.H.		26
I. W.	48.4	127	s. alk.	d.		27
II.				d. 524		28
IV. Br.			s. alk.	693		29
W.	i.	i.		fusible		30
IV., W.	i.		s. alk., HNO_3			31
Am. Y.	i.	i.	i. alk.	d.		32
Bl.	d.		d. alk.	d.		33
IV.	0.004	s.s.	i. alc., s. alk.	937		34
Cryst.	v.s.s.			d.		35

	Name.	Formula.	Formula Weight.	Density. Water=1 D : Air=1
1	Lead sulphate (basic)	$PbSO_4PbO$	526.5	
2	— sulphide	PbS	239.3	7.25—7.7
3	— tetrachloride	$PbCl_4$	349.0	3.18/0°
4	Lithium	Li	6.94	0.5936
5	— bromide	$LiBr$	86.86	3.464/25°
6	— carbide	Li_2C_2	37.89	1.65/18°
7	— carbonate	Li_2CO_3	73.88	2.111
8	— chlorate	$2LiClO_3+H_2O$	198.82	
9	— chloride	$LiCl+2\,H_2O$	78.43	2.068/25°
10	— fluoride	LiF	25.94	2.54
11	— hydride	LiH	7.95	
12	— hydroxide	$LiOH$	23.95	
13	— iodide	$LiI+3\,H_2O$	187.91	3.48
14	— nitrate	$LiNO_3$	68.95	2.334/92.5°
15	— oxide	Li_2O	29.88	2.10/15°
16	— perchlorate	$LiClO_4+3\,H_2O$	160.45	
17	— phosphate	$2Li_3PO_4+H_2O$	249.74	2.41
18	— platinichloride	$Li_2PtCl_6+6\,H_2O$	529.9	
19	— sulphate	$Li_2SO_4+H_2O$	127.96	2.02
20	— sulphite	$Li_2SO_3+H_2O$	111.96	
21	Magnesium	Mg	24.32	1.75
22	— bromate	$Mg(BrO_3)_2+6\,H_2O$	388.26	2.29
23	— bromide	$MgBr_2+6\,H_2O$	292.26	
24	— carbonate	$MgCO_3$	84.32	3.056
25	— — (basic)	$3MgCO_3.Mg(OH)_2+3\,H_2O$	365.37	2.18
26	— chlorate	$Mg(ClO_3)_2+6\,H_2O$	299.34	
27	— chloride	$MgCl_2+6\,H_2O$	203.34	1.558/17°
28	— fluoride	MgF_2	62.32	2.97
29	— hydrogen phosphate	$MgHPO_4+7\,H_2O$	246.48	
30	— hydroxide	$Mg(OH)_2$	58.34	2.34
31	— iodate	$Mg(IO_3)_2+4\,H_2O$	446.22	3.28
32	— iodide	MgI_2	278.14	
33	— nitrate	$Mg(NO_3)_2+6\,H_2O$	256.44	1.46
34	— oxide	MgO	40.32	3.36 cryst.; 3.58 am.

Crystalline form and colour	Solubility* in 100 parts water at 15°C (60°F)	100 parts water at 100°C (212°F)	Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
W.	1 :22816	v.s.s.	s.s. H_2SO_4	d.		1
I.	i.	i.	i. alc.	R.H.	subl.	2
	d.			−15	d. 105	3
	d.		d. alc.	186	>950	4
Cryst.	143/0°	270/103°		442		5
W. pdr.	d.					6
W.	1.37	0.728	i. alc.	618		7
II.	deliq.		v.s. alc.	50	aq 90	8
II., an. I.	76.5	125	v.s. alc.	606	d. W.H.	9
C.	0.27 (14°)			R.H.		10
W.	d.			680		11
W.	s.s.			R.H.		12
V.	164	476		72	aq 120	13
IIIa	55.2	227.3	v.s. alc.	258		14
W.	5 (0°)	s.		vol. 600		15
IIIa	deliq.	s.	s. alc.	2 aq 100 3 aq 150		16
	0.04		s. ac.			17
III., V.	s.	s.	s. alc.	aq 180		18
V.	34.6/18°	29.2	s. alc.	an. 853		19
Needles	s.		s.s. alc.	R.H.		20
W.	i.	d. steam	s. ac.	750	1100	21
I.	71.4			6 aq 200	d.	22
III.	103.4 (18°)	v.s.		165	d.	23
IIIa, IV	i.	i.	s. CO_2 soln.	d. 350		24
V.	v.s.s.	v.s.s.		d.		25
W. cryst.	deliq.	s.	s. alc.	40	d. 120	26
V.	54	v.s.	s. alc.	d. >186		27
II.	0.076/18°		i. ac.			28
III.	s.s.		s. ac.	4 aq 100		29
IIIa	0.0009(18°)		s. NH_4Cl	d.		30
V.	10.6	33		4 aq 210	d.	31
W. cryst.	148 (18°)		s. alc.	fusible		32
V., VI.	73.4 (18°)		s. alc.	90, 5 aq 100	d.	33
I.	s.		s. alc.	2250		34

Name.	Formula.	Formula Weight.	Density. Water=1 D:Air=1
1 Magnesium pyrophosphate	$Mg_2P_2O_7+3\ H_2O$	276.77	2.56
2 — sulphate (epsomite)	$MgSO_4+7\ H_2O$	246.50	1.678/16°
3 — — (kieserite)	$MgSO_4+H_2O$	138.40	2.35
4 — sulphide	MgS	56.38	2.85 cryst.; 2.2 am.
5 — sulphite	$MgSO_3+6\ H_2O$	212.48	
6 Manganese	Mn	54.93	8.0
7 — dioxide	MnO_2	86.93	4.82
8. — heptoxide	Mn_2O_7	221.86	
9 — tetrachloride	$MnCl_4$	196.77	
10 — tetrafluoride	MnF_4	130.93	
11 — trioxide	MnO_3	102.93	
12 Manganic metaphosphate	$Mn_2(PO_3)_6+2\ H_2O$	620.13	
13 — oxide	Mn_2O_3	157.86	4.75 cryst.; 4.32 am.
14 — — hydrated	$Mn_2O_2(OH)_2$	175.88	4.33
15 — sulphate	$Mn_2(SO_4)_3$	398.04	
16 Mangano-manganic oxide	Mn_3O_4	228.79	4.72–4.85cryst
17 Manganous carbonate	$MnCO_3$	114.93	3.45–3.60 nat.
18 — chloride	$MnCl_2+4\ H_2O$	197.91	1.91
19 — hydroxide	$Mn(OH)_2$	88.95	3.26
20 — iodide	$MnI_2+4\ H_2O$	380.83	
21 — nitrate	$Mn(NO_3)_2+6\ H_2O$	287.05	1.82/21°
22 — oxide	MnO	70.93	5.09
23 — sulphate	$MnSO_4+4\ H_2O$	223.05	2.107/4°
24 — sulphate	$MnSO_4+7\ H_2O$	277.10	3.1 an.
25 — sulphide	$MnS\ (+H_2O)$	87.00	4.04
26 Mercuric acetylide	$3\ C_2Hg,\ H_2O$	691.8	5.3

Crystalline form and colour	Solubility* in 100 parts water at 15°C (60°F)	100 parts water at 100°C (212°F)	Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
Am. W.	i.	i.	i. alc	5 aq 150		1
IV., V.	33.8	73.8	s. alc	6 aq 150 7 aq 200		2
IV.	v.s.s.	s.				3
Am. Br.	s.s.	d.		d.		4
III.	1.25	0.83		6 aq 260		5
Gr.	slow d.	d.	s. ac.	1225		6
IV., Gr.	i.	i.	with HCl : Cl	d. 390		7
Bl.	s. d.		s. H_2SO_4	liq.	expl. 70	8
	s. to green	s.	s. ether			9
	s. to brown	d.				10
Bl.	$HMnO_4$		s. alk.	liq.	50	11
P.	s.s.	s.				12
II., Br.	i.	i.	i. acetic			13
II., Bl. Br.	i.	i.	s. ac.	to Mn_3O_4		14
G.	d.			d. 160		15
II., R.	i.	i.	s. ac. d.			16
IIIa, P.	i.	i.	i. alc., s. ac.	d.		17
V., P.	107 (10°)	116	s. alc.	2 aq 58 4 aq 198		18
W.	i.	i.	s. ac.	d.		19
O. needles	deliq.	v.s.				20
V., W.	v.s.	v.s.	s. alc.	+6 aq 25.8 +3 aq 35.5	d. 230	21
I., G.	i.	i.	s. ac.	W.H.		22
V.	63.8	52.9	i. alc.	stable 18—30		23
IV., V.	64.3	33.2	i. alc.	54 an. 400	5 aq 120 6 aq 200	24
I., G. ; Am. P.	i.	i.	s. alc.	fusible		25
W. pdr.	i.	i.	i. alc.	expl.		26

Name.	Formula.	Formula Weight.	Density. Water=1 D:Air=1
1 Mercuric bromide	$HgBr_2$	360.4	5.7
2 — chloride	$HgCl_2$	271.5	5.403; D:9.8
3 — cyanide	HgC_2N_2	252.6	3.99—4.02
4 — iodide	HgI_2	454.4	6.26
5 — potassium iodide	$2KHgI_3(+3\ H_2O)$	1294.9	4.25
6 — nitrate	$Hg(NO_3)_2$	324.6	
7 — oxide	HgO	216.6	11.136/4°
8 — sulphate	$HgSO_4(+2\ H_2O)$	296.7	6.47
9 — — (basic)	$HgSO_4+2\ HgO$	729.9	6.444
10 — sulphide	HgS	232.7	8.124
11 Mercurous bromide	Hg_2Br_2	561.0	7.037
12 — carbonate	Hg_2CO_3	461.2	D. 3.92/218°
13 — chloride	Hg_2Cl_2	472.1	6.48
14 — chromate	Hg_2CrO_4	517.2	
15 — iodide	Hg_2I_2	655.0	7.644
16 — nitrate	$Hg_2(NO_3)_2$	525.2	liq. :4.3/70°
17 — oxide	Hg_2O	417.2	8.95
18 — sulphate	Hg_2SO_4	497.3	7.12 ppd.
19 Mercury	Hg	200.6	13.59; D:6.93/18.5°
20 Microcosmic salt	$NH_4NaHPO_4+4\ H_2O$	209.15	1.55
21 Molybdenum	Mo	96.0	9.01
22 — dichloride	$MoCl_2$	166.9	
23 — dioxide	MoO_2	128.0	6.44/16°
24 — disulphide	MoS_2	160.1	4.88
25 — hexofluoride	MoF_6	210.0	
26 — pentachloride	$MoCl_5$	273.3	D:9.5/350°
27 — tetrasulphide	MoS_4	224.2	
28 — trioxide	MoO_3	144.0	4.39/21°
29 — trisulphide	MoS_3	192.2	
30 Molybdic acid	$H_2MoO_4+4\ H_2O$	234.08	
31 Nickel	Ni	58.68	8.8—8.9
32 — bromide	$NiBr_2+3\ H_2O$	272.57	
33 — chloride	$NiCl_2$	129.60	2.56

Crystalline form and colour	Solubility* in 100 parts water at 15°C (60°F)	100 parts water at 100°C (212°F)	Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
IV., W.	0.4		s. alc.	244	319	1
IV.	5.6	55.7	33 alc. 25 ether s. NaCl aq.	287	303—307	2
II.	12	53.8	5 alc.	d.		3
II., R.; IV., Y.	0.003	s.s.	0.8 alc.	241	349	4
Y.	s. forms	s.	s. alc., acetic	d.		5
	basic salt		s. HNO_3	79	d. R.H.	6
R. & Y.	0.005	v.s.s.	i. alc.	d. R.H.		7
W.	forms basic salt		i. alc.	d. R.H.		8
Y.	0.05	0.33	i. alc.	turns red		9
IIIa, R.; Am Bl.	i.	i.	s. aqua regia.	subl.		10
II., W.	i.	i.		subl. 350		11
Y.	i.	i.	i. alc.	d. 130		12
IV., W.	i.	i.	i. alc.	302	subl.	13
R. needles	i.	i.	i. alc.	d.		14
IV., G.	s.s.	i.	i. alc.	290	310	15
2 aq. V.	forms basic salt		s. dil. $HNOS_3$	70	d.	16
Bl.	i.	i.	i. alc.			17
V.	v.s.s.	d.	s. hot. H_2SO_4	d.		18
W.	i.		s. HNO_3, H_2SO_4	−38.9	357.25	19
V.C.	16	100	i. alc.	d.		20
W.			s. HNO_3, i. HCl	2420—2480		21
Y.	i.	i.	s. alc., s. HCl	subl.		22
II., Br. Bl.	i.	i.	i. aq. KOH			23
Bl. pdr.						24
W. cryst.	d.			17	35	25
Bl.	d.		s. alc., s. HCl	194	268	26
Br.	i.		s. KHS			27
IV., W. pd.	0.2	0.1	s. NH_4OH	759	d.	28
Br.	s.s.		s. KHS	d.		29
Y.	s.	s.	s. ac.			30
W.	i.		s. ac.	1452		31
Needles	deliq.	v.s.				32
Y.	s.	s.	s. alc.	subl.		33

Name.	Formula.	Formula Weight.	Density. Water=1 D:Air=1
1 Nickel chloride, hydrate	$NiCl_2+6\,H_2O$	237.70	
2 Nickelic hydroxide	$Ni_2(OH)_6$	219.41	
3 Nickel nitrate	$Ni(NO_3)_2+6\,H_2O$	290.80	2.065/14°
4 — phosphate	$Ni_3(PO_4)_2+7\,H_2O$	492.23	
5 — cyanide	NiC_2N_2	110.71	
6 — hydroxide	$Ni(OH)_2$	92.70	4.36
7 — oxide	NiO	74.68	6.4—6.8
8 — phosphide	Ni_3P_2	238.12	5.99
9 — sesquioxide	Ni_2O_3	165.36	4.846
10 — sulphide	NiS	90.74	
11 — sulphate	$NiSO_4$	154.74	3.418
12 — —, hydrate	$NiSO_4+6\,H_2O$	262.84	2.031
13 — —, hydrate	$NiSO_4+7\,H_2O$	280.86	1.98
14 — tetra-carbonyl	$Ni(CO)_4$	170.70	1.3185/17°
15 Nitric acid	HNO_3	63.02	1.54/0°
16 — —, hydrate	$HNO_3+32\%\,H_2O$		1.414/15.5°
17 — oxide	NO	30.01	0.00135
18 Nitrogen	N	14.01	liq.:0.804/ −199.5°
19 — iodide	$N_2H_3I_3$	411.80	3.5
20 — pentasulphide	N_2S_5	188.32	1.901/18°
21 — pentoxide	N_2O_5	108.02	1.64/18°
22 — sulphide	N_4S_4	184.28	2.22
23 — tetroxide	N_2O_4	92.02	liq.:1.4903/0°
24 — trichloride	NCl_3	120.39	1.65
25 — trioxide	N_2O_3	76.02	liq:1.447/ −2°
26 Nitrous oxide	N_2O	44.02	liq:1.226/ −89.4°
27 Nitrosyl bromide	NOBr	109.93	$<H_2O$
28 — chloride	NOCl	65.47	1.425/ −15°
29 Nitrosylsulphuric acid	$NO\cdot SO_2\cdot OH$	111.08	
30 — anhydride	$(SO_2\cdot NO_2)_2O$	236.14	
31 Nitroxyl chloride	NO_2Cl	81.47	1.316/14°
32 Osmium	Os	190.9	22.479
33 — monoxide	OsO	206.9	

Crystalline form and colour	Solubility* in 100 parts water at 15°C (60°F)	100 parts water at 100°C (212°F)	Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
III.	s.	s.	s. alc.			1
Bl.	i.	i.	s.ac., NH_4OH			2
V. G.	50	v.s.	s. alc.	56.7	136.7	3
G.	i.	i.	s. ac.			4
	i.	i.	s. KCN			5
G.	i.	i.	s.ac., NH_4OH			6
I. Gr.Bl. G	i.		s. NH_4OH			7
G. Bl.	i.	i.	i. HCl			8
Bl.			s. HCl reduc.	d.		9
III., Bl. Gr	i.		s.s.ac., s.KHS			10
Y.	36.5	61.9 (70°)	i. alc.			11
II. Bl., V.G	s.	s.	s. NH_4OH	6 aq 280		12
IV. G.	36.5	83.7		6 aq 103		13
C.	0.018 (9.8°)		s. alc.	−25	43.2	14
	m.	m.	d. alc.	−40.3	86	15
	m.	m.	d. alc.	liq.	120.5	16
	1 : 20 vol.	v.s.s.	s. $FeSO_4$ soln.	<-167	−153	17
	0.0235 : 1 vol. (4°)			−210	−199.5	18
dark R.	s.s. d.			expl.		19
R.	i.		s.s. CS_2, alc.	10—11	d.	20
IV.	s.	s.	d. alc.	30	d. 47	21
R. prism.	i.		s. CS_2	subl. 135	d. >178	22
	d.			−10.1	26	23
IV.	i. d.		s. org. solv.	liq.	expl. 95	24
R.	s.	d.	d.	−111	d. 3.5	25
	0.7778 : 1 vol.	s.s.	s.s. alc.	−103.7	−89.4/741mm.	26
Br.	d.			liq.	d. −2	27
Y.	d.			−60	−5.6/751mm.	28
IV.	d.		s. H_2SO_4	73		29
II.	d.		s. H_2SO_4	217	360	30
Y.	d.			liq.		31
I. W. Viol.	i.			2700		32
Gr. Bl.	i	i.	i. ac.			33

Name.	Formula.	Formula Weight.	Density. Water=1 D:Air=1
1 Osmium tetrachloride	$OsCl_4$	332.7	
2 — tetroxide	OsO_4	254.4	
3 Oxygen	O	16.00	liq :1.118/ −182.5°
4 Ozone	O_3	48.00	
5 Palladious bromide	$PdBr_2$	266.5	
6 — chloride	$PdCl_2+2\,H_2O$	213.7	
7 — cyanide	PdC_2N_2	158.7	
8 — iodide	PdI_2	360.5	
9 — sulphate	$PdSO_4+2\,H_2O$	238.8	
10 Palladium	Pd	106.7	11.4/22.5°
11 — hydrogen			11.06
12 — subsulphide	Pd_2S	245.5	7.36/15°
13 Perchloric acid	$HClO_4$	100.47	1.76/22°
14 — —, hydrate	$HClO_4+H_2O$	118.49	1.811
15 — —, dihydrate	$HClO_4+2\,H_2O$	136.51	1.7
16 Per-iodic acid	H_5IO_6	227.96	
17 Persulphuric acid	$H_2S_2O_8$	194.14	
18 Phosgene, *see* Carbonyl chloride			
19 Phospham	PHN_2	60.07	
20 Phosphomolybdic acid	$H_3PO_4\cdot 12MoO_3+12\,H_2O$	2042.3	
21 Phosphonium bromide	PH_4Br	114.99	
22 — chloride	PH_4Cl	70.53	
23 — iodide	PH_4I	161.99	
24 Phosphoretted hydrogen, gas.	PH_3	34.06	
25 — —, liq.	P_2H_4	66.11	1.016
26 — —, solid	P_4H_2	126.18	
27 Phosphoric acid, meta	HPO_3	80.05	
28 — —, ortho	H_3PO_4	98.06	liq. :1.88
29 — —, pyro	$H_4P_2O_7$	178.11	
30 Phosphorous acid	H_3PO_3	82.06	1.65/21°
31 Phosphorus, white	P	31.04	1.836/0°
32 —, red	P	31.04	2.16

Crystalline form and colour	Solubility* in 100 parts water at 15°C (60°F)	100 parts water at 100°C (212°F)	Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
R.	v.s.	s.	s. HCl, alc.			1
V. C.	s.	s.	s. alk., alc.	20	100	2
	4.89 vol./0°	i.	alc. 28.4 vol./0°	−230	−182.5	3
	v.s.s.		s. eth. oils	d. 270	−119	4
Br.	i.	i.	s. HBr			5
Bl., R.	s.	s.	s. HCl	R.H. & d.		6
Y.	i.	i.	s. KCN, NH_4OH	d.		7
Bl.	i.	i.	s. alc., KI	d. 100		8
R.	v.s.	v.s.				9
W. Gr.			s. HCl, HNO_3	1549	2300	10
				d.		11
Gr.	i.	i.	i. ac.	R.H.		12
	s.	s.		−35 liq.	39/56 mm.	13
Cryst.	s.	s.		50	expl. 110	14
	m.	s.		liq.	203	15
	s.			d. 133		16
	s.	d.				17
						18
W. pdr.	i.	i.	i.	infusible		19
V. Y.	s.			aq 104		20
I. C.	d.		d.		30	21
I.	d.			26	subl.	22
II. C.	d.		d.	subl.	80	23
	s.s.	i.		−133.5	−85	24
C.	i.	i.		<−10	57/735 mm.	25
Y.	i.	i.		ignites 160	d.	26
Glassy	s.	s.			Volatile bright R.H.	27
IV.	deliq.	v.s.	s. alc.	38.6	aq 160 and 290	28
	v.s.	v.s.	v.s.	61		29
C., cryst.	v.s.	v.s.		70.1	d. 200	30
I. C.	i.	i.	s. CS_2	44.2	290	31
Am., R. Br.	i.	i	i. CS_2			32

Name.	Formula.	Formula Weight.	Density. Water=1 D:Air=1
1 Phosphorus, black	P	31.04	2.34
2 — di-iodide	P_2I_4	569.76	
3 — oxybromide	$POBr_3$	286.80	2.822
4 — oxychloride	$POCl_3$	153.42	D:5.334/151°; 1.69/5°
5 — oxyfluoride	POF_3	104.04	3.7
6 — pentabromide	PBr_5	430.64	
7 — pentachloride	PCl_5	208.34	D:3.60/296°
8 — pentafluoride	PF_5	126.04	
9 — pentaselenide	P_2Se_5	458.08	
10 — pentasulphide	P_2S_5	222.38	
11 — pentoxide	P_2O_5	142.08	2.387
12 — tribromide	PBr_3	270.80	2.925/0°
13 — trichloride	PCl_3	137.42	1.6129/0°
14 — tri-iodide	PI_3	411.80	
15 — trioxide	P_2O_3	110.08	liq:1.936/25°; solid:2.135/21
16 Phosphoryl imidoamide	$PO(NH)(NH_2)$	78.08	
17 — nitride	PON	61.05	
18 — triamide	$PO(NH_2)_3$	95.12	
19 Platinic bromide	$PtBr_4$	514.9	
20 — chloride	$PtCl_4+5\,H_2O$	427.1	
21 — hydroxide	$Pt(OH)_4$	263.2	
22 Platinous bromide	$PtBr_2$	355.0	
23 — chloride	$PtCl_2$	266.1	5.87
24 — cyanide	PtC_2N_2	247.2	
25 — hydroxide	$Pt(OH)_2$	229.2	
26 — iodide	PtI_2	449.0	
27 Platinum	Pt	195.2	21.4
28 — dioxide	PtO_2	227.2	
29 — disulphide	PtS_2	259.3	7.224
30 — monosulphide	PtS	227.3	
31 — monoxide	PtO	211.2	
32 Potassamide	KNH_2	55.12	

Crystalline form and colour	Solubility* in 100 parts water at 15°C (60°F)	Solubility* in 100 parts water at 100°C (212°F)	Solubility* in Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
IIIs	i.	i.	i. CS_2			1
Y.R. cryst.	d.		s. CS_2	110		2
Cryst.	d.		s. H_2SO_4	55—56	195	3
	d.		d.	−1.5	110	4
C.	d.			−68	−40	5
Y. cryst.	d.		d.	<100	d. 100	6
II, W. cryst	d.		i. CS_2	148 under pressure	subl. 162	7
	d.			−83	−75	8
Bl.	d.		i. CS_2, s. CCl_4	d.		9
Y. cryst.	d.		s. CS_2	275	530	10
Am. W.	deliq.	d.		subl R.H.		11
C.	d.		d.	−41.5	175	12
C.	d.		s. CS_2	−112	76	13
R. cryst.	d.		s. CS_2	55	d.	14
Am., W.	d.		s. CS_2, C_6H_6	22.5	173.1	15
Am. W.	i.	d.		d.		16
Am. W.	i.	i.		R.H.		17
Am. W.	i.	i.	s. alc., i. ac.	d.		18
Br.	s.s.	s.s.	s. alc.			19
V. R.	s.	v.s.	s. alc.	d.		20
Br.			s. ac., KOH			21
G.	i.	i.	s. HBr		d. 200	22
Gr.G.	i.	i.	s. HCl	d.		23
Y.Br.	i.	i.	i. alc.			24
Bl.			s. HCl			25
Bl.	i.		s. ac., KOH	d. 350		26
	i.		s. HCl+HNO_3	1755		27
Bl.						28
Gr.Bl.	i.		s. HCl, HNO_3	d.		29
Bl.	i.		i. ac.			30
Gr.				d.		31
Y.Gr.	d.			270—272	subl. 400	32

Name.	Formula.	Formula Weight.	Density. Water=1 D:Air=1
1 Potassium	K	39.10	D:3.1/1040°; 0.8650/15°
2 — aluminate	K_2AlO_4	196.4	
3 — antimonate	$KSbO_3$	207.3	
4 — arsenate	K_3AsO_4	256.26	
5 — —	K_2HAsO_3	202.17	
6 — aurate	$AuO{\cdot}OK+3H_2O$	322.4	
7 — aurichloride	$AuCl_3{\cdot}KCl+2H_2O$	414.2	
8 — auricyanide	$AuC_3N_3{\cdot}KCN+H_2O$	358.4	
9 — aurocyanide	$AuCN{\cdot}KCN$	288.3	
10 — bicarbonate	$KHCO_3$	100.11	2.25
11 — bisulphate	$KHSO_4$	136.17	2.163
12 — bisulphite	$KHSO_3$	120.17	
13 — borofluoride	KBF_4	126.1	2.51/20°
14 — bromate	$KBrO_3$	167.02	3.271/17.5°
15 — bromide	KBr	119.02	2.681/15°
16 — carbonate	K_2CO_3	138.2	2.267
17 — carbonyl	$K_6C_6O_6$	402.63	
18 — chlorate	$KClO_3$	122.56	2.34/17°
19 — chloride	KCl	74.56	1.995/15°
20 — chromate	K_2CrO_4	194.2	2.7
21 — chromicyanide	$K_3Cr(CN)_6$	325.4	
22 — cobalticyanide	$K_3Co(CN)_6$	332.36	1.906
23 — cobaltinitrite	$K_3Co(NO_2)_6$	452.33	
24 — cobalt sulphate	$K_2SO_4{\cdot}CoSO_4+6H_2O$	437.39	2.154/40°
25 — cyanate	$KCNO$	81.12	2.048
26 — cyanide	KCN	65.12	1.52/16°
27 — dichromate	$K_2Cr_2O_7$	294.2	2.69/4°
28 — dihydrogen phosphate	KH_2PO_4	136.16	2.3
29 — disulphate	$K_2S_2O_7$	254.32	2.27
30 — dithionate	$K_2S_2O_6$	238.32	2.28
31 — ferric sulphate	$K_2SO_4{\cdot}Fe_2(SO_4)_3+24H_2O$	1006.60	
32 — ferricyanide	$K_6Fe_2(CN)_{12}$	658.46	1.82/17°
33 — ferrocyanide	$K_4Fe(CN)_6+3H_2O$	422.38	1.85/17°

Crystalline form and colour	Solubility* in 100 parts water at 15°C (60°F)	100 parts water at 100°C (212°F)	Alcohol, acids or alkalies	M P. °C.	B.P. °C.	
II., W.	d.		d. alc.	62.5	720	1
	s.					2
	i.	d.				3
Needles	18.87	v.s.	s. alc.			4
	v.s.	v.s.				5
Y. needles	s.	v.s.				6
IV. plates	s.	s.				7
C.	s.	s.	i. alc.			8
IV. C.	14.3	200				9
V.	25.07	83.0	alc. h. 0.083	d.		10
IV, V.	v.s.	v.s.		197	d.	11
W. needles	s.	s.	i. alc.	d. 190		12
W. cryst.	s.		s. alc.			13
IIIa.	6.667	49.75	s.s. alc.	d. 703		14
I.	63.0	102.0	alc. 0.5	745	sub. W.H.	15
V.	109	156	i. alc.	880	d. 810	16
Gr.R.	expl.		d. alc.	expl.		17
V.	6.0	56.5	alc. 0.833	370	d. 400	18
I.	33.4	56.6	alc. 0.5	770	subl W.H.	19
IV., Y.	61.9	79.1	i. alc.	R.H.		20
V., Y.	i.	i.	s. ac., alk.	3 aq in vac 4 aq 100		21
	v.s.	v.s.	i. alc.	d.		22
Y. prism.	s.s.	s.s.	i. alc.			23
V. plates	32.5	v.s.				24
B. needles	s.		s. alc.			25
I.	v.s.		v.s.s. alc.	R.H.	R.H.	26
VI., R.	9.9	94.1	i. alc.	400	d.	27
II.	v.s.		i. alc.	d.		28
Needles	s.	d.		210	d.	29
III. C.	6	75	i. alc.	d.		30
I. Viol.	20	v.s.				31
V. R.	40	80	i. alc	d.		32
V. Y.	28	100	i. alc	3 aq 60—8[illegible]		33

Name.	Formula.	Formula Weight.	Density. Water=1 D:Air=1
1 Potassium fluoride	$KF+2\,H_2O$	94.1	2.454
2 — hydride	KH	40.11	
3 — hydrogen phosphate	K_2HPO_4	174.25	
4 — — sulphide	KHS	72.17	
5 — hydroxide	KOH	56.11	2.044
6 — hypochlorite	$KClO$	90.56	
7 — hypophosphite	KH_2PO_2	104.16	
8 — iodate	KIO_3	214.02	3.97/18°
9 — iodide	KI	166.02	D:5.5/1320°; 3.04/24°
10 — iodotetrachloride	$KICl_4$	307.86	
11 — magnesium chloride	$KCl.MgCl_2+6\,H_2O$	277.90	1.618
12 — manganate	K_2MnO_4	197.13	
13 — manganic sulphate	$K_2SO_4\cdot Mn_2(SO_4)_3+24\,H_2O$	1004.78	
14 — manganicyanide	$K_6Mn_2(CN)_{12}$	656.64	
15 — mangonocyanide	$K_8Mn_2(CN)_{12}+6\,H_2O$	842.94	
16 — metabisulphite	$K_2S_2O_5$	222.32	
17 — molybdate	K_2MoO_4	238.2	
18 — nickel sulphate	$K_2SO_4\cdot NiSO_4+6\,H_2O$	437.10	2.124
19 — nitrate	KNO_3	101.11	2.087/15°
20 — nitrite	KNO_2	85.11	
21 — oxide	K_2O	94.20	2.656
22 — palladichloride	K_2PdCl_6	397.7	2.8
23 — palladiochloride	K_2PdCl_4	326.7	2.738
24 — pentasulphide	K_2S_5	238.50	
25 — perborate	KBO_3	98.1	
26 — perchlorate	$KClO_4$	138.56	2.54
27 — periodate	KIO_4	230.02	
28 — permanganate	$KMnO_4$	158.03	2.70/10°
29 — peroxide	K_2O_4	142.20	
30 — persulphate	$K_2S_2O_8$	270.32	
31 — phosphate, meta	KPO_3	118.14	2.26
32 — —, ortho	K_3PO_4	212.34	
33 — —, pyro	$K_4P_2O_7+3\,H_2O$	306.33	2.33
34 — platinibromide	K_2PtBr_6	752.9	4.541

Crystalline form and colour	Solubility* in 100 parts water at 15°C(60°F)	100 parts water at 100°C(212°F)	Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
I.	deliq.	v.s.	s.s. alc.	an. 885		1
W. needles	d.		reacts C_2H_2	burns in F Cl and O		2
	deliq.	v.s.	v.s. alc.	d.		3
IIIa, C.	s.	s.	s. alc.	455		4
+2aq.,IIIa	200	v.s.	s. alc.	R.H.	subl. W.H.	5
Needles	v.s.	v.s.		d.		6
III.	deliq.			d.		7
I.	7.2	32	i. alc.	560	d.	8
I.	140	209	alc. 2.5	685	723	9
V.	d.			d.		10
III., C., R.	64.5 (18.8°)	d.		R.H.		11
V., G., Bl.	s.	d.	s. alk.			12
I., Viol.	d.					13
R.	s.					14
II. B.	s.					15
V. plates	s.	d.	s.s. alc.	d.		16
Micro cryst.	s.	s.				17
V. B.	11.3	45.6 (75°)				18
IV., IIIa	26	247	i. alc.	334, 340	d.	19
	deliq.	v.s.	s. alc.			20
Gr.	v.s.	v.s.	v.s. alc.	R.H.		21
I. R.	s.s.	d.	i. alc.	d.		22
	s.	s.	s.s. alc.	d.		23
Y.Br.	v.s.	v.s.	v.s. alc.	abt. 220°		24
V.	v.s.	v.s.				25
IV.	1.667	18.18	i. alc.	610		26
IV.	0.345	s.		582		27
IV. R.Bl.	6.45	v.s.	d.	d. 240		28
Y.	d.		alc. d.	R.H.	d. W.H.	29
VI.	1.76	d.		d.		30
Am. W.	i.		s. ac.	infusible		31
IV.	s.		i. alc.			32
	s.	v.s.		aq 100, 180, 300		33
I., R.	2	10				34

Name.	Formula.	Formula Weight.	Density. Water=1 D:Air=1
1 Potassium platinichloride	K_2PtCl_6	486.2	3.344
2 — platinobromine	K_2PtBr_4	593.1	
3 — platinochloride	K_2PtCl_4	415.2	3.3/20°
4 — platinocyanide	$K_2Pt(CN)_4+3H_2O$	431.5	2.52
5 — plumbate	$K_2PbO_3+3H_2O$	387.45	
6 — selenate	K_2SeO_4	221.4	3.0657/20°
7 — silicate	K_2SiO_3	154.5	
8 — silicofluoride	K_2SiF_6	220.5	2.66
9 — silver cyanide	KCN Ag CN	199.00	
10 — sodium carbonate	$KNaCO_3+6H_2O$	230.20	1.61
11 — stannate	K_2SnO_3	244.9	3.197
12 — sulphate	K_2SO_4	174.26	2.66/20°
13 — sulphide	K_2S	110.26	2.13
14 — sulphite	$K_2SO_3+2H_2O$	194.30	
15 — tetraborate	$K_2B_4O_7+5H_2O$	324.3	1.74
16 — tetrasilicate	$K_2Si_4O_9$	335.4	
17 — thiocyanate	KCNS	97.18	1.91
18 — thiosulphate	$K_2S_2O_3+H_2O$	208.34	
19 — tri-iodide	KI_3	419.86	3.498
20 Red lead	Pb_3O_4	685.6	8.62
21 Rhodium	Rh	102.9	12.1
22 — cæsium alum	$Rh_2(SO_4)_3Cs_2SO_4+24H_2O$	1228.1	
23 — chloride	$RhCl_2+4H_2O$	281.3	
24 — nitrate	$Rh_2(NO_3)_6+4H_2O$	649.9	
25 Rubidium	Rb	85.45	1.5220/15°
26 — bromide	RbBr	165.37	2.78
27 — carbonate	Rb_2CO_3	230.90	
28 — chlorate	$RbClO_3$	168.91	
29 — chloride	RbCl	120.91	2.2
30 — hydride	RbH	86.46	2.0
31 — hydroxide	RbOH	102.46	
32 — iodide	RbI	212.37	3.02—3.44
33 — nitrate	$RbNO_3$	147.46	3.131

Crystalline form and colour	Solubility* in 100 parts water at 15°C(60°F)	100 parts water at 100°C(212°F)	Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
I., Y.	0.92	5.26		d.		1
IV., Bl.	v.s	v.s.				2
II. R.	s.	s.	i. alc.			3
IV. Y.	deliq.	s.	s. H_2SO_4, alc.	an. 100	d. R.H.	4
II. C.	d.		s. KOH			5
IV.	115 (12°)					6
Am.	s.	s.				7
I.	0.126	2	i. alc.	d. R.H.		8
W.	12.5	100	4 alc.			9
V.	20				6 aq 100	10
V. C.	s.	s.	s.s. KOH			11
IV.	10.3	26.2	i. alc.	1070	subl.	12
P.	v.s.	v.s.	s. alc.			13
IV.	100	v.s.	i. alc.	d.		14
III.	v.s.	v.s.		5 aq R.H.		15
Am.	s.	s.	i. alc.			16
	217 (20°)	v.s.	s. alc.	161		17
V.	v.s.	v.s.	i. alc.	aq 200		18
Prism.	d.		s. KI soln., alc	45	d.	19
R.	i.	i.	i. alc.	d. $>$400		20
W.			s.s. ac., s. fus. $KHSO_4$	1920		21
Y. oct.	s.s.			110—111		22
R.	s.		s. alc.			23
P.	s.	s.	i. alc.			24
W.	d.			38.5	R.H.	25
W.	98 (5°)	105 (16°)				26
C.	deliq.	v.s.		837	d. 740	27
W.	3 (5°)	5 (19°)				28
I. C.	82.9 (7°)			710		29
C. needles				d. 300 in vac		30
W.	1.18 (25°)	11.76	s. alc.	$<$R.H.		31
	137 (7°)	152 (18°)		R.H.		32
III. needle	19.5 (0°)	452	v.s. HNO_3			33

	Name.	Formula.	Formula Weight.	Density. Water=1 D : Air=1
1	Rubidium perchlorate	$RbClO_4$	184.91	
2	— platinichloride	Rb_2PtCl_6	578.9	
3	— sulphate	Rb_2SO_4	266.96	3.64
4	Ruthenium tetroxide	RuO_4	165.7	liq>H_2SO_4
5	Selenic acid	$H_2SeO_4(+xH_2O)$	145.2	2.95/15°
6	Selenious acid	H_2SeO_3	129.2	3.01/15.7°
7	Selenium, metal.	Se	79.2	4.80
8	—, cryst.	Se	79.2	4.5
9	—, amorph.	Se	79.2	D : 5.68/1400°;
				4.26/20°
10	— dioxide	SeO_2	111.2	3.95/15°
11	— monobromide	Se_2Br_2	318.2	3.604/15°
12	— monochloride	Se_2Cl_2	229.3	2.91/17°
13	— mono-iodide	Se_2I_2	412.2	
14	— monosulphide	SeS	111.3	3.056/0°
15	— nitride	Se_2N_2	186.4	
16	— oxychloride	$SeOCl_2$	166.1	2.44
17	— potassium cyanide	KCN·Se	144.3	
18	— tetrabromide	$SeBr_4$	398.9	
19	— tetrachloride	$SeCl_4$	221.0	
20	— tetra-iodide	SeI_4	586.9	
21	Silica	SiO_2	60.3	Cryst. 2.66;
				amorph.
				2.2/16°
22	Silicic acid (meta)	H_2SiO_3	78.3	2.324
23	Silico-bromoform	$SiHBr_3$	269.1	2.7
24	— chloroform	$SiHCl_3$	135.7	1.344
25	— iodoform	$SiHI_3$	410.1	3.4
26	Siicon, cryst.	Si	28.3	2.49
27	— carbide	SiC	40.3	3.22/15°
28	— disuphide	SiS_2	92.4	
29	— tetrabromide	$SiBr_4$	348.0	2.813/0°
30	— tetrachloride	$SiCl_4$	170.1	1.475
31	— tetrafluoride	SiF_4	104.3	
32	— tetrahydride	SiH_4	32.3	

Crystalline form and colour	Solubility* in 100 parts water at 15°C (60°F)	100 parts water at 100°C (212°F)	Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
IV.		1 (100°)				1
I. Y.	v.s.s.		i. alc.			2
IV. C.	42.4 (10°)			W.H.		3
IV. Y.	s. d		s. alc.	50	100	4
III. W.	m.	s.		58	260	5
C. cryst.	v.s.	v.s.		d.		6
Gr.	i.	i.	i. CS_2, s. H_2SO_4	217	690	7
V., R.Bl.	i.	i.	CS_2, 1 : 1000	220		8
R.	i.	i.	CS_2, 1 : 1000	100—250		9
W. cryst.	s.	s.			subl. 260	10
P.	d.		alc. d.	liq.	d. 225	11
Y.Br.	d.			liq.	d. 145	12
	d.			60—70		13
Y.	i.	i.	s. ether, CS_2	118—119		14
Am. Y.	i.	i.	i. alc., s. CS_2	expl. 200		15
W.	d.			10	179.5	16
Needles	s.		ac. d.	d. 100		17
Br.	d.		s. HCl, CS_2	75	d.	18
W.	d.		s. $POCl_3$	subl.	diss. 200	19
Gr.	d.			75—80		20
Am.&cryst	i.	i.	i. alc.	1780		21
Am. W.	freshly pptd. insol.		s. alk.			22
C.	d.				115—117	23
C.	d.		m. CS_2	-1.3	34	24
R.	d.			liq.	220	25
III. Bl., Am. Br.	i.	i	s. $HF+HNO_3$	1420±15		26
IV. plates	i.	i	i. ac.			27
W. needles	d.		d.	subl.		28
C.	d.			-12	153.4	29
C.	d.			-89	57.5	30
	d.			-102	-107	31
	i.			-200	-11/50atm.	32

G

Name.	Formula.	Formula Weight.	Density. Water=1 D:Air=1
1 Silicon tetra-iodide	SiI_4	536.0	
2 — tribromide	Si_2Br_6	536.1	
3 — trichloride	Si_2Cl_6	269.4	1.58/0°
4 — tri-iodide	Si_2I_6	818.1	
5 Silico-oxalic acid	$Si_2O_2(OH)_2$	122.6	
6 Silver	Ag	107.88	10.47
7 — arsenate	Ag_3AsO_4	462.60	
8 — arsenite	Ag_3AsO_3	446.60	
9 — bromate	$AgBrO_3$	235.80	5.196/16°
10 — bromide	AgBr	187.80	6.47/25°
11 — carbonate	Ag_2CO_3	275.76	6.077
12 — chlorate	$AgClO_3$	191.34	4.43
13 — chloride	AgCl	143.34	5.501 ppd.; D:5.7/1735°
14 — cyanide	AgCN	133.90	3.99
15 — dichromate	$Ag_2Cr_2O_7$	431.8	4.669
16 — fluoride	$AgF+H_2O$	144.90	
17 — iodate	$AgIO_3$	282.80	5.402/17°
18 — iodide	AgI	234.80	5.67/14°
19 — nitrate	$AgNO_3$	169.89	4.35/19°
20 — nitride	AgN_3	149.91	
21 — nitrite	$AgNO_2$	153.89	
22 — oxide	Ag_2O	231.76	7.52
23 — peroxide	Ag_2O_2	247.76	7.44
24 — phosphate	Ag_3PO_4	418.68	7.32
25 — —, pyro	$Ag_4P_2O_7$	605.60	5.306/7.5°
26 — sulphate	Ag_2SO_4	311.82	5.41
27 — sulphide	Ag_2S	247.82	7.24 nat.

Crystalline form and colour	Solubility* in 100 parts water at 15°C (60°F)	100 parts water at 100°C (212°F)	Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
I. C.	i.	i	s. CS_2	120.5	290	1
IV. W.	d.				240	2
W.	d.			−1	146	3
III. C.	d.		s. CS_2	250 in vac.		4
Am. W.	i.			d.		5
I. W.	i.	i	s. HNO_3	960.5	W.H.	6
R.	i.		s. NH_4OH			7
Y.	i.	i	s. HNO_3, NH_4OH	d.		8
II.	i.	i	s.s. HNO_3 s. NH_4OH			9
I. Y.	i.	i	s. conc. NH_4OH s. conc. HBr	427	d. 700	10
Y. pdr.			s. ac.	loses CO_2 at 200		11
II. W.	10			230	d. 270	12
I. W.	i.	i	s. NH_4OH, KCN, $Na_2S_2O_3$	460		13
W. cryst	i.	i	s. NH_4OH, KCN	m. and d.		14
VI. R.		d.				15
II. C.	deliq.	v.s.		435		16
W. needles	s.s.	s.s.	s. NH_4OH, HNO_3	d.		17
III. G.	i.		v.s.s. NH_4OH s. conc. KI	540		18
IV.	190	1110	alc. h. 1 : 4	218	d. R.H.	19
W.	i.		s. NH_4OH	expl.		20
IIIa, W.	s.s.	s.	s. NH_4OH	d. 150	d. R.H.	21
Bl.	0.333		s. HNO_3	d. 250		22
I. Bl.	i.		s. HNO_3, NH_4OH	d. 110		23
Y.	i.		s. alk., ac.	R.H.		24
W.	i.			585		25
IV.	0.5	1.45	v.s. NH_4OH	825		26
I., Gr.Bl.	i.		s. NH_4OH, HNO_3	676	d.	27

	Name.	Formula.	Formula Weight.	Density. Water=1 D : Air=1
1	Silver sulphite	Ag_2SO_3	295.82	
2	— thiocyanate	$AgCNS$	165.96	
3	— thiosulphate	$Ag_2S_2O_3$	327.90	
4	Sodamide	$NaNH_2$	39.03	
5	Sodium	Na	23.00	0.732/15°
6	— aluminate	$Na_2Al_2O_4$	164.2	
7	— aluminium chloride	$2NaCl.\ Al_2Cl_6$	383.9	
8	— ammonium phosphate	$NH_4NaHPO_4+4\ H_2O$	209.15	1.55
9	— antimonate	$2NaSbO_3+7\ H_2O$	508.5	
10	— bicarbonate	$NaHCO_3$	84.01	2.22/16°
11	— bisulphate	$NaHSO_4+H_2O$	138.09	an. 1.8
12	— bisulphite	$NaHSO_3$	104.07	1.48
13	— borate	$Na_2B_4O_7+10\ H_2O$	382.2	1.7156/17°
14	— bromate	$NaBrO_3$	150.92	3.339/17.5°
15	— bromide	$NaBr(+2\ H_2O)$	102.92	3.08
16	— carbonate	$Na_2CO_3+10\ H_2O$	286.16	1.45
17	— —, an.	Na_2CO_3	106.00	2.5
18	— chlorate	$NaClO_3$	106.46	2.29
19	— chloride	$NaCl$	58.46	2.174/20°
20	— chromate	$Na_2CrO_4+10\ H_2O$	342.2	2.71/16°
21	— dichromate	$Na_2Cr_2O_7+2\ H_2O$	298.0	2.52/16°
22	— dihydrogen phosphate	$NaH_2PO_4+H_2O$	138.08	2.04
23	— ferricyanide	$2\ Na_3Fe(CN)_6+H_2O$	579.88	
24	— ferrocyanide	$Na_4Fe(CN)_6+12\ H_2O$	520.18	
25	— fluoride	NaF	42.0	2.766
26	— hydrosulphite	$Na_2S_2O_4(+2\ H_2O)$	174.12	
27	— hydride	NaH	24.01	0.92
28	— hydrogen arsenate	$Na_2HAsO_4+12\ H_2O$	402.21	1.67
29	— — arsenite	Na_2HAsO_3	169.97	1.87
30	— — phosphate	$Na_2HPO_4+12\ H_2O$	358.29	1.525/16°
31	— — phosphite	$Na_2HPO_3+5\ H_2O$	216.13	

Crystalline form and colour	Solubility* in 100 parts water at 15°C (60°F)	100 parts water at 100°C (212°F)	Alcohol, acids or alkalies	M.P. °C.	B.P. °C	
W.	i.		s. NH_4OH	d. 400		1
W.	i.	i	s. NH_4OH	d.		2
W.	s.s.		s. NH_4OH	d.		3
Cryst.	s.	d.		155	subl. 400	4
II. (?), W.	d.		d.	97.5	742	5
	s.	s.				6
C.	deliq.			185	R.H.	7
V. C.	16	100	i. alc.	d.		8
W.				2 aq 200 an. R.H.		9
V.	8	d.	i. alc.	d. 270		10
V., an. VI.	v.s.	v.s.	i. alc.	300		11
	s.	s.	i. alc.			12
V.+5 aq. I	6.2	201.4	i. alc.	R.H.		13
I.	s.	s.		384		14
V., an. I.	87	120	s.s. alc.	733—765		15
V.	92.5	539.6	i. alc.	5 aq 12.5, 34	106	16
W. pdr.	16.5	45	i. alc.	853	d.	17
I.	94.2	232.6	s. alc.	248	d.	18
I.	35	39.5	i. alc.	792	W.H.	19
V. Y.	s.	s.		23		20
VI. R.	109	163		aq110 ; 320	d. 400	21
IV.	s.		i. alc.	d. 200		22
R. prism.	19.0	80.0				23
V. Y.	s.	s.				24
I. C.	4.78		s.s. alc.	902		25
C. cryst.	v.s.	d.	i. alc.	d. R.H.		26
C. cryst.	d.		s. fused Na	d.		27
	28	v.s.	1.8 alc.			28
	v.s.	v.s.				29
V.	aq. free 5.8	98.8	i. alc.	38	3 aq 160	30
IIIa	s.	s.		53		31

Name.	Formula.	Formula Weight.	Density. Water=1 D:Air=1
1 Sodium hydrogen sulphide	$NaHS+2H_2O$	92.10	
2 — hydroxide	$NaOH$	40.01	2.13
3 — hypochlorite	$NaClO$	74.46	
4 — hypophosphite	$NaH_2PO_2+H_2O$	106.08	
5 — iodide	$NaI+2H_2O$	185.95	2.448; an. 3.65/18°
6 — manganate	$Na_2MnO_4+10H_2O$	345.09	
7 metastannate	$Na_2Sn_5O_{11}+4H_2O$	887.6	
8 — molybdate	$Na_2MoO_4+2H_2O$	242.0	
9 — monoxide	Na_2O	62.00	2.805
10 — nitrate	$NaNO_3$	85.01	2.27/20°
11 — nitrite	$NaNO_2$	69.01	
12 — nitroprusside	$Na_2Fe(CN)_5NO+2H_2O$	297.96	
13 — perborate	$NaBO_3+4H_2O$	154.1	
14 — perchlorate	$NaClO_4$	122.46	
15 — permanganate	$NaMnO_4$	141.93	
16 — peroxide	Na_2O_2	78.00	2.8
17 — pentasulphide	$Na_2S_5(+8H_2O)$	206.30	
18 — phosphate, ortho	$Na_3PO_4+12H_2O$	380.28	1.62
19 — —, meta	$NaPO_3$	102.04	2.476
20 — —, pyro	$Na_4P_2O_7+10H_2O$	446.24	1.8
21 — phosphide	Na_3P	100.04	
22 — platinichloride	$Na_2PtCl_6+6H_2O$	562.1	2.499
23 — pyroantimonate	$Na_2H_2Sb_2O_7+6H_2O$	508.5	
24 — silicate	Na_2SiO_3	122.3	
25 — silicofluoride	Na_2SiF_6	188.3	2.75
26 — stannate	$Na_2SnO_3+3H_2O$	266.8	
27 — sulphate	$Na_2SO_4+10H_2O$	322.22	1.492/20°
28 — suphide	Na_2S+9H_2O	240.20	2.471
29 — suphite	$Na_2SO_3+7H_2O$	252.17	1.561
30 — tetrasilicate	$Na_2Si_4O_9$	303.2	
31 — thioantimonate	$Na_3SbS_4+9H_2O$	479.58	1.806
32 — thioarsenate	$2Na_3AsS_4+15H_2O$	814.74	
33 — thiosulphate	$Na_2S_2O_3+5H_2O$	248.20	1.736/10°

Crystalline form and colour	Solubility* in 100 parts water at 15°C (60°F)	100 parts water at 100°C (212°F)	Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
Cryst.	deliq.		s. alc.	d.		1
Am. W.	60	250	s. alc.	1100	W.H.	2
Needles	s.	d.		d.		3
	deliq.	s.		aq in vac.		4
I.	174	300	s. alc.	abt. 650		5
V. G.	v.s.	d.				6
Cryst. pdr.	s.s.		i. alc.			7
IIIa	s.	s.				8
	d.		d. alc.	R.H.	subl.	9
IIIa	84	180	93% alc. 0.93	313		10
IV.	83	v.s.	i. alc.	213		11
R. prism.	40					12
V. prism.	2.5 (20°)	d.	with H_2SO_4: H_2O_2			13
IIIa. C.	deliq.	v.s.		d.		14
R.	deliq.	v.s.		d.		15
Y.W.	s. d.		with H_2SO_4: H_2O_2	d.		16
	s.	s.	s.s. alc.	d.		17
III.	20	s.		73,11aq100		18
W.	fused i.			617		19
V.	8.8	93.1	i. alc.		76.7	20
R.	yields PH_3			d.		21
VI. R.	v.s.	v.s.	s. alc.	an. 100		22
	v.s.s.	v.s.s.	v.s.s. alc.			23
V.+5 aq.	s.	s.	i. alc.	1007		24
III. C.	0.6	2.5				25
III.	s.	s.s.				26
V., an. IV.	(+10 aq.) 39.8	322 (33°)	i alc.	7 aq 150; 880		27
II.	s.	s.	s. alc.	d.		28
V.	(+7 aq.) 25	100	i alc.	7 aq 150	d.	29
Am. C.	s.	s.	i. alc.			30
I. Y.	33		i. alc.	d.		31
	s.					32
V.	65	109 (45°)	i. alc.	32—48	d. 220	33

Name.	Formula.	Formula Weight.	Density. Water=1 D:Air=1
1 Sodium tungstate	$Na_2WO_4+2H_2O$	330.0	3.3; an. 4.18
2 Stannic acid or Metastannic acid	H_2SnO_3 to H_4SnO_4		
3 Stannic bromide	$SnBr_4$	438.4	3.340/35°
4 — chloride	$SnCl_4$	260.5	2.27/20°
5 — fluoride	SnF_4	194.7	4.78/19°
6 — iodide	SnI_4	626.4	4.696/11°
7 — oxide	SnO_2	150.7	6.6—6.9
8 — sulphide	SnS_2	182.8	4.6
9 Stannous bromide	$SnBr_2$	278.5	5.117/17°
10 — chloride	$SnCl_2+2H_2O$	225.7	2.71
11 — iodide	SnI_2	372.5	
12 — oxide	SnO	134.7	6.3
13 — sulphide	SnS	150.8	4.973 cryst.
14 Strontium	Sr	87.63	2.542
15 — bromate	$Sr(BrO_3)_2+H_2O$	361.49	3.773
16 — bromide	$SrBr_2(+6H_2O)$	247.47	4.2/24°
17 — carbonate	$SrCO_3$	147.63	
18 — chlorate	$Sr(ClO_3)_2$	254.55	3.62
19 — chloride	$SrCl_2+6H_2O$	266.65	1.964; an. 3.05
20 — dithionate	$SrS_2O_6+4H_2O$	319.81	2.373
21 — fluoride	SrF_2	125.63	4.2—4.24
22 — hydroxide	$Sr(OH)_2+8H_2O$	265.78	1.396
23 — iodide	SrI_2	341.47	4.415
24 — nitrate	$Sr(NO_3)_2$	211.65	2.962/4°
25 — oxide	SrO	103.63	3.6
26 — peroxide	SrO_2+8H_2O	263.76	

Crystalline form and colour	Solubility* in 100 parts water at 15°C (60°F)	100 parts water at 100°C (212°F)	Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
C. plates	(+2 aq.) 55.5	125		an. 100		1
W.	i.	stannic meta stannic	s. HNO_3, alk. i HNO_3, s. alk., HCl	d.		2
W.	v.s.	d.		33	201	3
	s., d. excess aq.		s. CS_2	liq. −33	114.1	4
W. cryst.	deliq.	d.		subl.	705	5
R. oct.	d.		s. org. sol.	143	341	6
II., Am. W	i.		s. alk., i. ac.	1130		7
Y. III.	i.		s. alk.	d. R.H.		8
Y.	s.			215.5	619	9
VI.	275	d. with excess aq.	s. alc.	40, an. 249	620	10
Y.B. ndl.	s.s.		s. HCl	316		11
I. Bl.	i.		s. NH_4Cl	d. R.H.		12
Gr.Bl.	i.		s. HCl	R.H.		13
Y.	d.			<800	abt. 1000	14
	(+aq.) 33			aq 100	d. 240	15
C. needles	99 (20°)	250 (110°)		498—630		16
IV.	0.0056		s. CO_2 soln.	d. 1160	d. R.H.	17
IV.	s.	s.	s.s.	290 and d.		18
III.	51.0	101.9	alc. 4.6	an. 854	4 aq 60 6 aq 100	19
III. plates	(+ aq.) 20	60	i. alc.	4 aq 78		20
I.	s.	s.				21
II.	(+8 aq.) 1.9	41		8 aq 100		22
Plates	179 (20°)	370		402		23
I. ; +4 aq. V.	62.8	101.1	v.s.s. alc.	d. 645		24
IV.	35 (0°)	s.	s. ac.	3000		25
W. cryst.	s.s.			d. R.H.	8 aq. <60	26

Name	Formula.	Formula Weight.	Density. Water=1 D : Air=1
1 Strontium silicofluoride	$SrSiF_6+2\,H_2O$	266.0	
2 — sulphate	$SrSO_4$	183.69	3.707 ppd.
3 — sulphide	SrS	119.69	3.7
4 — thiosulphate	$SrS_2O_3+5\,H_2O$	289.83	2.156
5 Sulphamide	$SO_2(NH_2)_2$	96.11	
6 Sulphur, oct.	S	32.06	2.0748
7 —, prism.	S	32.06	1.957
8 —, amorph.	S	32.06	2.046; D : 2.23/850°
9 — dichloride	SCl_2	102.98	1.62
10 — dioxide	SO_2	64.06	liq. 1.434/0°
11 — hexafluoride	SF_6	146.06	
12 — hexa-iodide	SI_6	793.58	
13 Sulphuric acid, conc.	H_2SO_4 (98.5%)		1.854
14 — —, vitriol	H_2SO_4 (92%)		1.835/20°
15 — —, hydrate	$H_2SO_4+H_2O$	116.10	1.788/17°
16 — —, hydrate	$H_2SO_4+2\,H_2O$	134.11	1.665/0°
17 — —	H_2SO_4	98.08	1.834/18°
18 — —, pyro	$H_2S_2O_7$	178.14	1.89
19 Sulphur monochloride	S_2Cl_2	135.04	1.706/0°
20 — monxytetra chloride	S_2OCl_4	221.96	1.656 D. 3.86/100°
21 — trioxide	SO_3	80.06	1.9546/13°
22 — —, solid	$(SO_3)_2$	160.12	1.040
23 — trioxytetrachloride	$S_2O_3Cl_4$	253.96	
24 Sulphuryl chloride	SO_2Cl_2	134.98	1.66/20°
25 Tantalum	Ta	181.5	16.5
26 — chloride	$TaCl_5$	358.8	
27 — oxide	Ta_2O_5	443.0	7.5 am.
28 Tetraphosphorus monoselenide	P_4Se_2	282.6	
29 — trisulphide	P_4S_3	220.34	
30 Telluric acid	$H_2TeO_4+2\,H_2O$	229.5	

Crystalline form and colour	Solubility* in 100 parts water at 15°C(60°F)	100 parts water at 100°C(212°F)	Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
	v.s.	v.s.				1
IV.	0.145	0.01	s.s. ac.	d. W.H.		2
I.	d.		s. alc.			3
V.	16.6 (10°)	50	i. alc.	4 aq 100		4
IV. plates	s.		s. alc.	91.5	d. 250	5
IV. Y.	i.	i	s.s. alc., s. CS_2	114—115	444.6	6
V.	i.	i	CS_2, 73 : 100	114.4	444.6	7
	i.	i	i. CS_2	>120		8
	d.			liq.	d. 70	9
Br.	688 vol. at 0°	170 vol. at 40°	alc. 328 vol. at 0°	−72.7	−10.1	10
W.	i.	s.s.	s.s. alc.	−55	−50	11
Gr.Bl.cryst		d.	s. CS_2			12
	m.	m.	d. alc.	liq.	315—317	13
	m.	m.	d. alc.	liq.		14
	m.	m.	d. alc.	+8	210—338	15
	m.	m.	d. alc.	−70	170—190	16
	m.	m.	d. alc.	10.5	d. 40	17
Prism.	d.		d.	35		18
Y.	d.		s. CS_2	liq.	138	19
R.	d.			liq.	100	20
W. needles	d.		d.	14.8	46.2	21
W. cryst.	d.			35		22
W. needles	d.			57	subl.	23
	d.		s. acetic	liq.	70.5	24
Gr.				2900		25
Y.	d.		s. alc.	221	241.6	26
Am. W.	i.		s. $KHSO_4$			27
	i.	i.	s. alc., ether, CS_2	−12		28
IV. Y.	i.	d.	s. CS_2, PCl_3, KHS soln.	166	>300	29
III.	s.		HCl d.	d. R.H.	2 aq 160	30

Name.	Formula.	Formula Weight.	Density. Water=1 D:Air=1
1 Tellurium	Te	127.5	D:9/1400°; 6.26
2 — dioxide	TeO_2	159.5	5.9/0°
3 — hydride	H_2Te	129.5	
4 — trioxide	TeO_3	175.5	5.07/15°
5 Tellurous acid	H_2TeO_3	177.5	
6 Thallic bromide	$TlBr_3$	443.8	
7 — chloride	$TlCl_3+H_2O$	328.4	
8 — hydroxide	$TlO(OH)$	237.0	
9 — nitrate	$Tl(NO_3)_3+3\,H_2O$	444.1	
10 — sulphate	$Tl_2(SO_4)_3+7\,H_2O$	822.3	
11 — sulphide	Tl_2S_3	504.2	
12 Thallium	Tl	204.0	11.862
13 — monoxide	Tl_2O	424.0	
14 — trioxide	Tl_2O_3	456.0	5.56/0°
15 Thallous bromide	TlBr	283.9	7.54/22°
16 — carbonate	Tl_2CO_3	468.0	7.164
17 — chloride	TlCl	239.5	7.02
18 — fluoride	TlF	223.0	
19 — hydroxide	$TlOH(+H_2O)$	221.0	
20 — iodide	TlI	330.9	7.07
21 — nitrate	$TlNO_3$	266.0	5.55
22 — phosphate	Tl_3PO_4	707.0	6.89/10°
23 — sulphate	Tl_2SO_4	504.1	6.765
24 — sulphide	Tl_2S	440.1	8
25 Thionyl chloride	$SOCl_2$	118.98	1.676
26 Thiophosphoric acid	$PS(OH)_3$	114.12	
27 Thiophosphoryl bromide	$PSBr_3$	302.86	2.85/17°
28 — chloride	$PSCl_3$	169.49	D:5.878/298°; 1.6816/0°
29 — triamide	$PS(NH_2)_3$	111.18	1.7/13°
30 Thiopyrophosphoryl bromide	$P_2S_3Br_4$	477.94	2.262/17°
31 Thorium chloride	$ThCl_4$	374.2	4.59
32 — nitrate	$Th(NO_3)_4$	480.4	

Crystalline form and colour	Solubility* in 100 parts water at 15°C (60°F)	100 parts water at 100°C (212°F)	Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
Gr.W.	i.	i	s. H_2SO_4	450	1390	1
I. Y.	i.			dark R.H.	<700	2
	s.		s. alc.	−54		3
Y. cryst.	i.				d. R.H.	4
W.	s.s.	d.		d. 40		5
Y. needles	s.	s.	s. alc.	d.		6
	v.s.	d.		aq 60	d. 100	7
Y. cryst.	s.		s. alc.	d. 100		8
C. cryst.	deliq.	d.		d. 100		9
C. cryst.	d.			6 aq 220	d.	10
Am. Bl.	i.	i	s.h. H_2SO_4		d.	11
Am.	i.		S. HNO_3	302	1280	12
Bl.	s.		s. ac.	300		13
III. Bl.	i.	i	s. HCl			14
W.				460		15
V.	5.2	22.4	i.	d. 272		16
I. W	0.265	1.427	i. HCl, alc.	451	719—731	17
Oct.	80	<80				18
	s.			d. 100		19
I. Y.	0.00625	0.125	s. HNO_3	439	800—806	20
IV.	10.6	508/108°	i. alc.	205		21
W.	0.5	0.75	i. alc.			22
IV.	4.8	19.3		632	d.	23
Br.	i.	i	s. ac.	d.		24
	d.			liq.	78.8	25
	s.	d.	s. alc.			26
Y.	d.		s. CS_2	38	d.	27
C.	d.			liq.	126	28
W.	s.s.	d.	s. alc.	d. 200		29
Y.	d.			liq.	d.	30
W. plates	deliq.			520	subl.	31
Plates	deliq.		s. alc.			32

Name.	Formula.	Formula Weight.	Density. Water=1 D:Air=1
1 Thorium oxide	ThO_2	264.4	9.87/15° cryst
2 Tin	Sn	118.7	7.29
3 Titanium	Ti	48.1	3.45, fus. 4.9
4 — dioxide	TiO_2	80.1	3.7—4.2
5 — tetrachloride	$TiCl_4$	189.9	1.76/0°
6 Triphosphonitrile chloride	$P_3N_3Cl_6$	347.91	1.98
7 Tungsten	W	184.0	19.13
8 — dioxide	WO_2	216.0	12.1
9 — hexachloride	WCl_6	396.8	D:13.3/350°
10 — pentachloride	WCl_5	361.3	3.52
11 — trioxide	WO_3	232.0	7.16 am.
12 — trisulphide	WS_3	280.2	
13 Tungstic acid hydrate	$H_2WO_4+H_2O$	268.0	
14 Uranium	U	238.2	18.68
15 — oxide	UO_2	270.2	10.9
16 — sulphate	$U(SO_4)_2+8\,H_2O$	574.5	
17 — tetrachloride	UCl_4	380.0	
18 Uranyl chloride	UO_2Cl_2	341.1	
19 — nitrate	$UO_2(NO_3)_2+6\,H_2O$	502.3	2.81
20 — phosphate	$UO_2(HPO_4)+4\,H_2O$	438.3	
21 — sulphate	$2UO_2SO_4+7\,H_2O$	859.6	
22 Vanadic acid, meta	HVO_3	100.0	
23 Vanadium	V	51.0	5.5
24 — dichloride	VCl_2	121.9	3.23
25 — monosulphide	V_2S_2	166.1	4.2—4.4
26 — monoxide	V_2O_2	134.0	3.64
27 — pentoxide	V_2O_5	182.0	3.5/20°
28 — sesquioxide	V_2O_3	150.0	4.72/16°
29 — sesquisulphide	V_2S_3	198.2	3.7, 4.0
30 — tetrachloride	VCl_4	192.8	1.8585
31 — trichloride	VCl_3	157.4	3/18°

Crystalline form and colour	Solubility* in 100 parts water at 15°C (60°F)	Solubility* in 100 parts water at 100°C (212°F)	Solubility* in Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
I., Am. W.	i.		s. conc. H_2SO_4	infusible		1
W. cryst.	i.		s.h. ac.	231.9	W.H.	2
Gr.		d.	s. HCl	1800—1850		3
II. IV.	i.			1500		4
	s.	d.		−25	136	5
	i. d.		s. alc., ether	114	250	6
II. Gr. W.	i.		s. HNO_3	3000±100		7
Br.	i.		s.s.ac.,s.KOH			8
Viol.Bl.	d. 60°		s. CS_2	275	346.7	9
Bl. cryst.	deliq.			248	275.6	10
IV. Y.	i.		s. alk.	R.H.		11
Bl.	s.s.	s.	s. alk.			12
W.	s.s.		s. alk.	at 100 : $H_2W_2O_7$		13
G., W.	i.	i	s. ac.	W.H.		14
I., G., Bl.	i.	i	i. conc. H_2SO_4	oxid.		15
G. cryst.	s.		i. alc.	d.		16
I. G.	v.s.	s.	s. alc.	gas		17
R., Br. Bl.	320 (18°)	s.	s. alc., ether	fusible	d.	18
Y. cryst	(+6aq.)200	v.s.	v.s. alc.	59.5	118	19
IV. Y.	i.	i	i. acetic acid	aq 60		20
Y.	v.s.	v.s.	s. H_2SO_4	an. 300		21
Y. Br.	s.	s.				22
Cryst.			s. HNO_3, conc. H_2SO_4	1730		23
III. Y.	s.	s.	s. alc.			24
Bl.			i. HCl, s. h. H_2SO_4			25
Gr. pdr.	i.	i	s. ac.			26
IV. R.	1 :1000		s. ac., alk.	658		27
Bl.	s.	s.	s. HNO_3,i.alk.	infusible		28
Bl. plates, Gr. pdr.			s.s. conc. ac. s. am. sulph.			29
R.Br.	s.			−18 liq.	154	30
R. plates	deliq.		s. alc.			31

	Name.	Formula.	Formula Weight.	Density. Water=1 D:Air=1
1	Vanadyl sulphate	$(VO)_2(SO_4)_3$	422.2	
2	— trichloride	$VOCl_3$	173.4	1.841
3	Water	H_2O	18.016	0.9568 100°/4° ice 0.91674 0°/0°
4	Yttrium oxide	Y_2O_3	225.4	5.046
5	— nitrate	$Y(NO_3)_3+6\,H_2O$	382.8	
6	Zinc	Zn	65.37	6.86—7.21 D :2.26/1400
7	— bromate	$Zn(BrO_3)_2+6\,H_2O$	429.31	
8	— bromide	$ZnBr_2$	225.31	3.643
9	— carbonate	$ZnCO_3+H_2O$	143.39	4.42
10	— chlorate	$Zn(ClO_3)_2+6\,H_2O$	340.39	
11	— chloride	$ZnCl_2$	136.29	2.91/25°
12	— hydroxide	$Zn(OH)_2$	99.39	2.877
13	— iodide	ZnI_2	319.21	4.696
14	— nitrate	$Zn(NO_3)_2+6\,H_2O$	297.49	
15	— oxide	ZnO	81.37	5.61
16	— phosphate	$Zn_3(PO_4)_2$	386.19	3.99/15°
17	— sulphate	$ZnSO_4+7\,H_2O$	287.54	1.96 ; 3.4 an.
18	— sulphide	ZnS	97.43	4.0
19	Zirconium chloride	$ZrCl_4$	232.4	
20	— fluoride	ZrF_4	166.6	4.433
21	— oxide	ZrO_2	122.6	5.1—5.7

Crystalline form and colour	Solubility in 100 parts water at 15°C (60°F)	Solubility in 100 parts water at 100°C (212°F)	Alcohol, acids or alkalies	M.P. °C.	B.P. °C.	
B.	deliq.					1
Y.	d.			– 15 liq.	126.7	2
III.			m. alc.	0	100	3
W. cryst.	i.		s. mineral ac.			4
C. plates	deliq.		s. alc., ether	17, – 6 aq		5
III., W.	i.	slight d.	s. ac.	419.4	930	6
I.	s.	s.		100	6 aq 200	7
	s.	s.	s. alc., ether	390	695	8
IIIa, an.	i.	i	i. alc.	d. 300		9
I. W.	s.	s.	s. alc.	60		10
W. cryst.	330 (10°)	v.s.	alc. 1 : 1	262	730	11
IV ;+aq.I.	i.	i	s. alk., ac.	d.		12
	deliq.	v.s.	s. alc.	d.		13
II.	deliq.	v.s.	s. alc.	36.4	6 aq 105	14
III. W.	1 : 100000		s. alc.	W.H.		15
Prism.		655		R.H.		16
IV.	(+7aq.)135		i.	6 aq 100	aq R.H.	17
I. W.	i.	i	s. ac.	1049		18
W.	v.s.	s. d.	s. alc.			19
III. C.	i.		i. ac.	W.H.		20
II., V			s. conc. H_2SO			21

GENERAL PROPERTIES OF

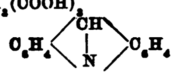
Name.	Formula.	Formula Weight.	Empirical Formula.
1 Abiëtic acid	$C_{20}H_{30}O_2$	303.32	$C_{20}H_{30}O_2$
2 Acenaphthene	$C_{10}H_6:(CH_2.CH_2)$	154.14	$C_{12}H_{10}$
3 Acenaphthylene	$C_{10}H_6:(CH:CH)$	152.12	$C_{12}H_8$
4 Acetal	$CH_3.CH:(OC_2H_5)_2$	118.14	$C_6H_{14}O_2$
5 Acetaldehyde	$CH_3.CHO$	44.04	C_2H_4O
6 — semi-carbazone	$CH_3.CH:N.NH.CO.NH_2$	87.09	$C_3H_7ON_3$
7 Acetamide	$CH_3.CO.NH_2$	59.06	C_2H_5ON
8 — chloride	$CH_3.CCl_2.NH_2$	113.98	$C_2H_5NCl_2$
9 Acetamidine	$CH_3.C(NH)NH_2$	58.08	$C_2H_6N_2$
10 Acetanilide	$C_6H_5.NH.COCH_3$	135.12	C_8H_9ON
11 Acetic acid	$CH_3.COOH$	60.04	$C_2H_4O_2$
12 Acetate, ammonium	CH_3COONH_4	77.08	$C_2H_7O_2N$
13 — calcium	$(CH_3COO)_2Ca.2H_2O$	194.17	$C_4H_6O_4Ca$
14 — cupric	$(CH_3COO)_2Cu.H_2O$	199.66	$C_4H_6O_4Cu$
15 — ferric	$(CH_3COO)_6Fe_2$	465.88	$C_{12}H_{18}O_{12}Fe_2$
16 — lead	$(CH_3COO)_4Pb$	443.34	$C_8H_{12}O_8Pb$
17 — — (sugar of lead)	$(CH_3COO)_2Pb.3H_2O$	379.32	$C_4H_6O_4Pb$
18 — — basic	$CH_3COO.PbO.PbOH$	506.44	$C_2H_4O_4Pb_2$
19 — potassium	CH_3COOK	98.13	$C_2H_3O_2K$
20 — sodium	$CH_3COONa.3H_2O$	136.08	$C_2H_3O_2Na$
21 — uranyl	$(CH_3COO)_2UO_2.3H_2O$	442.32	$C_4H_6O_6U$
22 — zinc	$(CH_3COO)_2Zn.3H_2O$	223.47	$C_4H_6O_4Zn$
23 — allyl	$CH_3COOC_3H_5$	100.09	$C_5H_8O_2$
24 — amyl	$CH_3COOC_5H_{11}$	130.15	$C_7H_{14}O_2$
25 — benzyl	$CH_3COOC_7H_7$	150.13	$C_9H_{10}O_2$
26 — ethyl	$CH_3COOC_2H_5$	88.08	$C_4H_8O_2$
27 — ethylene	$(CH_3COO)_2:C_2H_4$	146.11	$C_6H_{10}O_4$
28 — hexyl	$CH_3COOC_6H_{13}$	144.17	$C_8H_{16}O_2$
29 — methyl	CH_3COOCH_3	74.06	$C_3H_6O_2$
30 — methylene	$(CH_3COO)_2:CH_2$	132.09	$C_5H_8O_4$
31 — naphthyl, α	$CH_3COOC_{10}H_7$	186.14	$C_{12}H_{10}O_2$
32 — — β	,, ,,	186.14	,,
33 Acetic anhydride	$(CH_3CO)_2:O$	102.07	$C_4H_6O_3$
34 Acetin, mono	$(OH)_2:C_3H_5.O.COCH_3$	134.11	$C_5H_{10}O_4$
35 Acetnaphthalide, α	$C_{10}H_7.NH.COCH_3$	185.16	$C_{12}H_{11}ON$
36 — β	,, ,,	185.16	,,

ORGANIC COMPOUNDS.

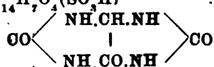
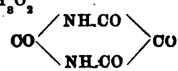
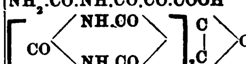
Density $H_2O=1$.	Solubility in— Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
	i.	s.	s.s. acetic	153—154		1
1.08		c.s.s.		95	277.5	2
	i.	v.s.	v.s.	93	265—275 d.	3
0.821/22°	c. 1 : 18	v.s.	s.	liq.	104	4
0.778/16°	v.s.	s.	s.	- 120.7	20.8	5
	s.s.	s.s.		162		6
1.159	v.s.	v.s.	v.s.	83	215.5/749mm.	7
	d.				88—89/762mm.	8
	d.		s. ac.			9
1.21/4°	1 : 189	s.	s.	113	283	10
1.05704/15°	m.	s.	s.	16.68	117.88	11
1.073	v.s.			120		12
	s.	s.s.		100 an.		13
1.882	h. 1 : 5	1 : 14		100 an.	d. 240	14
	s.	s.				15
				175		16
2.496	c. 1 : 1.5	s.		75, an. 280		17
	1 : 18	s.s.				18
	del. 1 : 0.5	c. 1 : 3	i.	292	d. R.H.	19
1.42	1 : 2.8	s.s.		58, an. 319		20
	s.	s.		aq. 100, 275		21
1.735	v.s.			235—237	3 aq. 100	22
0.9376/0°		s.		liq.	105	23
0.879/20°	i.	s.	s.	liq.	148	24
1.057/16.5°				liq.	215.3/756mm.	25
0.9048/0°	1 : 17/17.5°	m.	m.	- 82.8	77.2	26
$>H_2O$	s.s.	s.	s.	liq.	185	27
0.8902/0°				liq.	169.2	28
0.957/0°	s.	s.		- 101.2	56.95	29
aq.				liq.	169—171/745	30
	d.	s.	s.	46		31
	i.	s.	s.	70		32
1.0757/21°				liq.	137.9	33
1.20				131/2-3mm.		34
	h.s.	v.s.		159		35
	h.v.s.	s.		132		36

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Aceto-acetanilide	$CH_3CO.CH_2CO.NH.C_6H_5$	177.15	$C_{10}H_{11}O_2N$
2 — acetic acid	$CH_3CO.CH_2COOH$	102.07	$C_4H_6O_3$
3 — — ether	$CH_3CO.CH_2COOC_2H_5$	130.11	$C_6H_{10}O_3$
4 — — —, benzyl	$CH_3CO.CH(C_7H_7)COOC_2H_5$	220.19	$C_{13}H_{16}O_3$
5 — benzidine	$NH_2.C_6H_4.C_6H_4.NH.COCH_3$	226.20	$C_{14}H_{14}ON_2$
6 — diphenylamine	$(C_6H_5)_2:N.COCH_3$	211.18	$C_{14}H_{13}ON$
7 — thiamide	$CH_3.CS.NH_2$	75.11	C_2H_5NS
8 — toluidine, *o*	$C_7H_7.NH.COCH_3$	149.14	$C_9H_{11}ON$
9 — — *m*	,, ,,	149.14	,,
10 — — *p*	,, ,,	149.14	,,
11 Acetol	$CH_3CO.CH_2OH$	74.06	$C_3H_6O_2$
12 Aceton acid, see	Hydroxy butyric acid		
13 Acetone	CH_3COCH_3	58.06	C_3H_6O
14 — chloride	$CH_3CCl_2CH_3$	100.98	$C_3H_6Cl_2$
15 — cyanhydrin	$(CH_3)_2C(OH)CN$	85.09	C_4H_7ON
16 — diacetic acid	$CO:(CH_2.CH_2COOH)_2$	174.12	$C_7H_{10}O_5$
17 — dicarboxylic acid	$CO:(CH_2COOH)_2$	146.07	$C_5H_6O_5$
18 — phenylhydrazone	$(CH_3)_2:C:N.NH.C_6H_5$	148.15	$C_9H_{12}N_2$
19 Acetonitrile	CH_3CN	41.04	C_2H_3N
20 Acetonylurea	$C_5H_8N_2O_3$	128.07	$C_5H_8O_3N_2$
21 Acetophenine	$C_{24}H_{19}N$	321.28	$C_{24}H_{19}N$
22 Acetophenone	$C_6H_5.COCH_3$	120.10	C_8H_8O
23 — acetone	$C_6H_5.COCH_2.CH_2COCH_3$	176.15	$C_{11}H_{12}O_2$
24 Acetoxime	$(CH_3)_2:C:NOH$	73.08	C_3H_7ON
25 Acetoxybenzoic acid 1:3:4	$CH_3CO.C_6H_3(OH)COOH$	180.11	$C_9H_8O_4$
26 Aceturic acid	$CH_3CO.NH.CH_2COOH$	117.09	$C_4H_7O_3N$
27 Acetyl acetone	$CH_3CO.CH_2COCH_3$	100.09	$C_5H_8O_3$
28 — amino benzoic acid, *o*	$CH_3CO.NH.C_6H_4COOH$	179.13	$C_9H_9O_3N$
29 — — — — — *m*	,, ,,	179.13	,,
30 — — — — — *p*	,, ,,	179.13	,,
31 — — phenol, *o*	$CH_3CO.NH.C_6H_4OH$	151.12	$C_8H_9O_2N$
32 — benzoic acid, *o*	$CH_3CO.C_6H_4COOH$	164.11	$C_9H_8O_3$
33 — — —, *p*	,, ,,	164.11	,,
34 — bromide	$CH_3CO.Br$	122.95	C_2H_3OBr
35 — carbazole, 9	$C_{12}H_8N.COCH_3$	209.17	$C_{14}H_{11}ON$
36 — chloride	$CH_3CO.CI$	78.49	C_2H_3OCl
37 — —, chloro	$CH_2Cl.CO.Cl$	112.95	$C_2H_2OCl_2$
38 — —, dichloro	$CHCl_2.COCl$	147.40	C_2HOCl_3

Density $H_2O=1$.	Solubility in Water.	Solubility in Alcohol.	Solubility in Ether.	M.P. °C.	B.P. °C.	
	s.s.	s.	s.	85		1
	v.s.			liq.	100	2
1.0282/20°	s.s.			<-80	181	3
1.036/14.5°				liq.	283—284	4
	i.	v.s.	i.	38—40		5
			s.	103		6
	v.s.	s.		108.5		7
	0.86 : 100	s.		112—115	296	8
	0.44 : 100	s.		65.5	303	9
	0.06 : 100	s.		147	307	10
	m.	m.	m.		147	11
						12
0.7971/15°	m.	m.	m.	-94.9	56.1	13
1.827/16°				-34.6	69.6	14
				-19.5	120	15
	s.s.	s.	s.s.	142—143		16
1.1107/20°	v.s.	v.s.	v.s.	135	d. 250	17
		v.s.		15—16	165/91mm.	18
0.7891	m.	s.			93	19
0.8018/4°	v.s.	v.s.	v.s.	-41	175	20
		s.s.		135		21
1 0272/20°	s.s.			20.8	201.5	22
	c.s.s.				d.	23
	v.s.	v.s.	v.s.	60	135	24
	h.s.	s.	s.	129		25
	v.s.	v.s.		206		26
0.9745/20°	1 : 8	s.	s.		139—746mm.	27
	c.s.s.	s.	s. acetic	185		28
	c.s.s.	h.s.	s.s.	248	subl.	29
	s.s.	s.	s.s.	253—254		30
	h.v.s.	v.s.		201		31
	h.s.			114—115		32
	s.s.	s.s.	s.s.	205	subl.	33
					81	34
	s.s.	v.s.	v.s.	69	>360	35
1.1051/20°	d.			liq.	51—52/720	36
1.495					106	37
					108—111	38

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Acetyl disulphide	$(CH_3CO)_2S_2$	160.19	$C_4H_6O_2S_2$
2 — glycine	$CH_3CO.NH.CH_2COOH$	117.09	$C_4H_7O_3N$
3 — indole, 3	$CH_3CO.C_8H_5NH$	159.13	$C_{10}H_9ON$
4 — —, 1	,, ,,	159.13	,,
5 — iodide	$CH_3CO.I$	169.15	C_2H_3OI
6 — isatin	$C_6H_4:(CO)_2:N.COCH_3$	189.12	$C_{10}H_7O_3N$
7 — malonic ester	$CH_3CO.CH:(COOC_2H_5)_2$	202.56	$C_9H_{14}O_5$
8 — methyl urea	$CH_3.NH.CO.NH.COCH_3$	116.10	$C_4H_8O_2N_2$
9 — naphthol, α	$C_{10}H_7O.COCH_3$	186.14	$C_{12}H_{10}O_2$
10 — —, β	,, ,,	186.14	,,
11 — oxamic ester	$CH_3CO.NH.CO.COOC_2H_5$	159.11	$C_6H_9O_4N$
12 — peroxide	$(CH_3CO)_2O_2$	118.07	$C_4H_6O_4$
13 — phenol	$C_6H_5O.COCH_3$	136.10	$C_8H_8O_2$
14 — phenyl hydrazine	$C_6H_5.NH.NH.COCH_3$	150.14	$C_8H_{10}ON_2$
15 — propionic acid	$CH_3CO.C_2H_4.COOH$	116.09	$C_5H_8O_3$
16 — pyrrole	$C_4H_4N.COCH_3$	109.10	C_6H_7ON
17 — quinine	$C_{20}H_{23}O_2N_2.COCH_3$	336.34	$C_{22}H_{26}O_3N_2$
18 — salicylic acid	$COOH.C_6H_4O.COCH_3$	180.11	$C_9H_8O_4$
19 — succinic ester	$CH_3CO.CH(COOC_2H_5)$ $CH_2.COOC_2H_5$	216.18	$C_{10}H_{16}O_5$
20 — thiocyanate	$CH_3CO.SCN$	105.17	C_3H_3ONS
21 — thio-urea	$NH_2.CS.NH.COCH_3$	118.14	$C_3H_6ON_2S$
22 — urea	$NH_2.CO.NH.COCH_3$	102.08	$C_3H_6O_2N_2$
23 Acetylene	$CH : CH$	26.03	C_2H_2
24 — dicarboxylic acid	$COOH.C : C.COOH$	114.04	$C_4H_2O_4$
25 — dichloride	$CHCl:CHCl$	96.95	$C_2H_2Cl_2$
26 — urea	$C_2H_2(CON_2H_2)_2$	142.11	$C_4H_6O_2N_4$
27 Achroodextrine	$C_{36}H_{62}O_{31}$	990.68	$C_{36}H_{62}O_{31}$
28 Aconic acid	$CH_2CO.O.CH:C.COOH$	129.07	$C_5H_4O_4$
29 Aconine	$C_{25}H_{41}NO_9$	499.46	$C_{25}H_{41}O_9N$
30 Aconitic acid	$C_3H_3(COOH)_3$	174.08	$C_6H_6O_6$
31 Acridine		179.15	$C_{13}H_{19}N$
32 Acrolein	$CH_2:CH.CHO$	56.05	C_3H_4O
33 Acrylic acid	$CH_2:CH.COOH$	72.05	$C_3H_4O_2$
34 Adenine, see	Amino-purine		
35 Adipic acid	$COOH.(CH_2)_4.COOH$	146.11	$C_6H_{10}O_4$
36 Adipinketone, see	Keto-pentamethylene		
37 Æsculetin	$C_9H_6O_4.H_2O$	196.11	$C_9H_6O_4$

Density $H_2O=1$.	Solubility in Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
	i.	s.	s. CS_2	20	d.	1
	2.7 : 100/15°	s.	i.	d. 130		2
	s.			189	subl.	3
					152—153/14	4
1.98/17°	d.			liq.	108	5
	s.s.	s.	s. C_6H_6	200—201		6
1.080/23°		s.		liq.	238—240	7
	h.s.s	s.s.	s.s.	180—181		8
1.1336/0°		v.s.	v.s.	46	296	9
				70		10
	i.	s.	s.	52—54		11
				30	63/21mm.	12
1.0927/0°					193	13
	s.s.	s.	s.s.	128		14
1.135/15°	v.s.	v.s.	v.s.	33	239	15
	s.s.	s.	s.	90	218	16
		v.s.	v.s.	108		17
	1 : 945	s.	s.	135		18
1.079/ 18—21°	i.	s.		liq.	254—256	19
1.151/16°	d.				132—133	20
	h.s.	s.	s.s.	165		21
		s.	h.s.	214		22
	1 : 1	6 : 1		−81.5		23
	v.s.	v.s.	v.s.	178—179		24
				liq.	55	25
	1 : 1075/17°	s.	s. ac.		300 d.	26
	s.	i.				27
	1 : 5.6		s.s.	164		28
	v.s.	v.s.	i.	130		29
	18 : 100	1 : 2	v.s.	191		30
	h.s.s.	s.	s.	107	>360	31
<H_2O	1 : 2.5	s.	s.	liq.	50	32
1.0621/16°	m.			10.1—10.3	140	33
						34
	1.44 : 100	v.s.	.605 : 100	149	265/100mm.	35
						36
	c.s.s.	s.	s. alk.	d. 270		37

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Æsculin	$2C_{15}H_{16}O_9.3H_2O$	734.46	$C_{15}H_{16}O_9$
2 Aldehyde ammonia	$CH_3.CHOH.NH_2$	61.08	C_2H_7ON
3 Aldehydin	$CH_3.C_5H_3N(C_2H_5)$	120.13	$C_8H_{10}N$
4 Aldehydo-benzoic acid, *o*	$COOH.C_6H_4.CHO$	150.09	$C_8H_6O_3$
5 — — —, *p*		150.09	,,
6 — hydroxy-benzoic acid, 3 : 4 : 1	$COOH.C_6H_3OH.CHO$	166.09	$C_8H_6O_4$
7 — — — —, 4 : 3 : 1	,, ,,	166.09	,,
8 — — — —, 3 : 2 : 1	,, ,,	166.09	,,
9 — — — —, 2 : 5 : 1	,, ,,	166.09	,,
10 Aldol	$CH_3.CHOH.CH_2.CHO$	88.08	$C_4H_8O_2$
11 Alizarin	$C_6H_4:(CO)_2:C_6H_2:(OH)_2$	240.13	$C_{14}H_8O_4$
12 — amide, *o*	$C_6H_4:(CO)_2:C_6H_2(OH)NH_2$	239.15	$C_{14}H_9O_3N$
13 — carboxylic acid, 1 : 8 : 2	$COOH.C_6H_3:(CO)_2:C_6H_2:(OH)_2$	284.14	$C_{15}H_8O_6$
14 — sulphonic acid	$C_{14}H_7O_4(SO_3H)$	320.19	$C_{14}H_8O_7S$
15 Allantoin		158.11	$C_4H_6O_3N$
16 Allanturic acid	$NH_2.CO.NH.CO.COOH$	132.07	$C_3H_4O_4N_2$
17 Allocinnamic acid	$C_9H_8O_2$	148.11	$C_9H_8O_2$
18 Alloxan		142.06	$C_4H_2O_4N_2$
19 Alloxanic acid	$NH_2.CO.NH.CO.CO.COOH$	160.07	$C_4H_4O_5N_2$
20 Alloxantin		268.11	$C_8H_4O_7N_4$
21 Allyl acetic acid	$C_3H_5.CH_2.COOH$	100.09	$C_5H_8O_2$
22 — acetone	$CH_3.CO.CH_2.C_3H_5$	98.11	$C_6H_{10}O$
23 — alcohol	C_3H_5OH	58.06	C_3H_6O
24 — amine	$C_3H_5NH_2$	57.08	C_3H_7N
25 — aniline	$C_6H_5NH.C_3H_5$	133.14	$C_9H_{11}N$
26 — benzene	$C_6H_5.C_3H_5$	118.13	C_9H_{10}
27 — bromide	C_3H_5Br	120.98	C_3H_5Br
28 — chloride	C_3H_5Cl	76.52	C_3H_5Cl
29 — cyanide	C_3H_5CN	67.07	C_4H_5N
30 — ether	$(C_3H_5)_2:O$	98.11	$C_6H_{10}O$
31 — ethyl	$C_3H_5.C_2H_5$	70.11	C_5H_{10}

Density $H_2O=1$.	Solubility in Water.	Solubility in Alcohol.	Solubility in Ether.	M.P. °C.	B.P. °C.	
	1 : 670/10°	h. 1 : 24	i.	an. 160 d.		1
	s.		s.s.	70—80	100	2
	i.	s.	s.		180	3
				97		4
	s.s.	v.s.	s.s.	246		5
	h.s.s.	s.	s.	234		6
	h.s.	s.	s.	243—244	subl.	7
	1 : 15/100°	s.		179		8
	1 : 150/100°	h.s.	s.	248—249		9
1.1094/16°	m.	m.	s.	syrup	83/20mm.	10
	i.	s.	s., s. alk.	290	430	11
	i.	s.	s.	225	subl. 150	12
	v.s.s.	s.	s.s.	321—322	subl.	13
	s.	s.	i.			14
	c. 0.6 : 100, h. 3.3 : 100	s.s.	i.	232—233		15
	del.	i.				16
	0.845 : 100/25°			68		17
	s.	s.			c. 170	18
	s.	1 : 5	s.s.	d.		19
	v.s.s.	v.s.s.	v.s.s.			20
0.9842/15°	s.s.	s.	s.	liq.	182	21
0.892/27°	i.			liq.	239—241/759	22
0.857/15°	m.	s.		liq.	96.6/753mm.	23
0.7631/20°	m	s.		liq.	56.5/756mm.	24
0.982/19°	v.s.s.	s.		oil.	208—209	25
0.918/15°		s.		liq.	155	26
1.461/0°	i.				70—71/752	27
0.9379/20°	i.	s.		−136.4	44.6	28
0.849/0°		s.		liq.	119	29
0.8046/18°	i.	s.		liq.	94.3	30
				liq.	37	31

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Allyl ethyl ether	$C_3H_5.O.C_2H_5$	86.11	$C_5H_{10}O$
2 — iodide	C_3H_5I	167.98	C_3H_5I
3 — isocyanide	$C_3H_5.NC$	67.07	C_4H_5N
4 — malonic acid	$C_3H_5.CH:(COOH)_2$	144.09	$C_6H_8O_4$
5 — mercaptan	C_3H_5SH	74.12	C_3H_6S
6 — phenyl ether	$C_6H_5.O.C_3H_5$	134.13	$C_9H_{10}O$
7 — — urea	$C_6H_5.NH.CO.NH.C_3H_5$	176.16	$C_{10}H_{12}ON_2$
8 — pyridine	$C_3H_5.C_5H_4N$	119.12	C_8H_9N
9 — sulphide	$(C_3H_5)_2:S$	114.17	$C_6H_{10}S$
10 — thiocyanate	$C_3H_5.SCN$	99.13	C_4H_5NS
11 — *iso*-thiocyanate	$C_3H_5.NSC$	99.13	,,
12 — trisulphide	$(C_3H_5)_2S_3$	174.26	$C_6H_{10}S_3$
13 Allylene	$CH_3.C:CH$	40.05	C_3H_4
14 — dichloride	$CH_3.CCl:CHCl$	110.97	$C_3H_4Cl_2$
15 Aluminium ethyl	$Al(C_2H_5)_3$	114.25	$C_6H_{15}Al$
16 — methyl	$Al(CH_3)_3$	72.19	C_3H_9Al
17 Amalic acid (tetramethyl alloxantine)	$(CH_3)_4\ C_8N_4O_7$	324.20	$C_{12}H_{12}O_7N_4$
18 Amino acetic acid (glycine)	$NH_2.CH_2COOH$	75.05	$C_2H_5O_2N$
19 — anthraquinone, *a*	$C_{14}H_7O_2.NH_2$	223.15	$C_{14}H_9O_2N$
20 — azobenzene, *p*	$NH_2.C_6H_4.N_2.C_6H_5$	197.12	$C_{12}H_{11}N_3$
21 — azonaphthalene, *a*	$C_{10}H_7.N_2.C_{10}H_6.NH_2$	297.25	$C_{20}H_{15}N_3$
22 — —, *β*	,, ,,	297.25	,,
23 — azotoluene, $CH_3:N:N:CH_3:NH_2$ = 1 : 2 : 5 : 1 : [illegible]	$CH_3.C_6H_4.N_2.C_6H_3(NH_2)CH_3$	225.22	$C_{14}H_{15}N_3$
24 — —, 1 : 3 : 5 : 1 : 2	,, ,,	225.22	,,
25 — —, 1 : 4 : 5 : 1 : 2	,, ,,	225.22	,,
26 — —, 1 : 4 : 6 : 1 : 3	,, ,,	225.22	,,
27 — benzaldehyde, *o*	$NH_2.C_6H_4.CHO$	121.10	C_7H_7ON
28 — —, *m*	,, ,,	121.10	,,
29 — —, *p*	,, ,,	121.10	,,
30 — benzamide, *m*	$NH_2.C_6H_4.CONH_2$	136.12	$C_7H_8ON_2$
31 — —, *p*	,, ,,	136.12	,,
32 — benzene sulphonic acid, *o*	$NH_2.C_6H_4.SO_3H.\frac{1}{2}H_2O$	182.17	$C_6H_7O_3NS$
33 — — — —, *m*	,, ,, $\frac{1}{2}H_2O$	182.17	,,
34 — — — —, *p*	,, ,, $2H_2O$	209.19	,,

Density $H_2O=1$.	Solubility in Water.	Solubility in Alcohol.	Solubility in Ether.	M.P. °C.	B.P. °C.	
				liq.	64	1
1.85/12°	i.			liq.	102/734mm.	2
0.794/14°	s.s.	s.		liq.	119	3
	s.	s.	s.	103—105	d.	4
	i.	h.s.s.	i.	liq.	90	5
	i.			liq.	193	6
				115		7
0.9595	v.s.	v.s.	i.		189—190	8
0.88765/26.8°	s.s.			liq.	140	9
1.071/0°	i.			liq.	180—181	10
1.0057/24.2°	s.s.	s.	s.	−80	150.7	11
1.012/15°	i.	i.	m.		188	12
	s. cupram.		s.	−110	−23.5	13
1.23/27°				liq.	55	14
	expl.			−18	194	15
				liq.	130	16
	h.s.s.	v.s.s.	s. KOH	176 d.		17
1.1607	23 : 100	0.2 : 100		240	d.	18
	i.	s.s.	s.s.	243	subl.	19
	h.s.s.	s.s.	s.s.	127	225/120mm.	20
	s. H_2SO_4	s.s.	s.s.	173—175		21
				159		22
		s.		100		23
	v.s.s	s.		80		24
	i.	s.		127—128		25
		s.		127		26
	s.s.	v.s.	v.s.	39—40	d.	27
			v.s.			28
	s.	s.		70		29
	s.	s.		75		30
	s.s.	s.		179		31
	1.66 : 100/11°	s.				32
	1 : 68/15°	s.				33
	1 : 166/10°			d. 280		34

	Name.	Formula.	Formula Weight.	Empirical Formula.
1	Amino benzoic acid, *o*	$NH_2.C_6H_4.COOH$	137.10	$C_7H_7O_2N$
2	———, *m*	,, ,,	137.10	,,
3	———, *p*	,, ,,	137.10	,,
4	— benzophenone, *o*	$C_6H_5.CO.C_6H_4.NH_2$	197.16	$C_{13}H_{11}O_2N$
5	——, *m*	,, ,,	197.16	,,
6	——, *p*	,, ,,	197.16	,,
7	— benzoyl benzoic acid, *o*	$C_7H_5O.NH.C_6H_4.COOH$	241.17	$C_{14}H_{11}O_3N$
8	—————, *m*	,, ,,	241.17	,,
9	—————, *p*	,, ,,	241.17	,,
10	— butyric acid, *a*	$C_2H_5.CH(NH_2).COOH$	103.10	$C_4H_9O_2N$
11	———, *β*	$CH_3.CH(NH_2)CH_2.COOH$	103.10	,,
12	— camphor	$C_{10}H_{15}O.NH_2$	167.20	$C_{10}H_{17}ON$
13	— caproic acid	$(CH_3)_2:CH.CH_2.CH(NH_2).COOH$	131.14	$C_6H_{13}O_2N$
14	— *iso*-caproic acid	,, ,,	131.14	,,
15	— cinnamic acid, *o*	$NH_2.C_6H_4.C_2H_2.COOH$	163.13	$C_9H_9O_2N$
16	———, *m*	,, ,,	163.13	,,
17	———, *p*	,, ,,	163.13	,,
18	— dimethylaniline, *p*	$NH_2.C_6H_4.N:(CH_3)_2$	136.16	$C_8H_{12}N_2$
19	— diphenyl, *o*	$C_6H_5.C_6H_4.NH_2$	169.16	$C_{12}H_{11}N$
20	——, *p*	,, ,,	169.16	,,
21	— diphenylamine	$NH_2.C_6H_4.NH.C_6H_5$	184.18	$C_{12}H_{12}N$
22	— ethyl benzene, *o*	$C_2H_5.C_6H_4.NH_2$	121.14	$C_8H_{11}N$
23	———, *p*	,, ,,	121.14	,,
24	—— phenol, *p*	$C_2H_5.NH.C_6H_4OH$	137.14	$C_8H_{11}ON$
25	— guanidine	$NH:C(NH_2)NH.NH_2$	74.09	CH_6N_4
26	— hexahydro benzene	$NH_2.C_6H_5(H_6)$	99.14	$C_6H_{13}N$
27	— naphthol, 7 : 2	$NH_2.C_{10}H_6OH$	159.13	$C_{10}H_9ON$
28	——, 1 : 2	,, ,,	159.13	,,
29	——, 4 : 1	,, ,,	159.13	,,
30	— nitro benzoic acid, $COOH:NH_2:NO_2=$ 1 : 2 : 5	$C_6H_3(NH_2)(NO_2)COOH$	182.10	$C_7H_6O_4N_2$
31	1 : 2 : 3	,, ,,	182.10	,,
32	1 : 3 : 6	,, ,,	182.10	,,
33	1 : 3 : 2	,, ,,	182.10	,,
34	1 : 3 : 5	,, ,,	182.10	,,

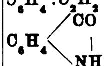
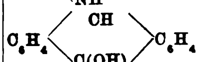
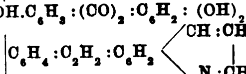
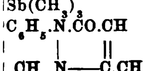
Density $H_2O=1$.	Solubility in Water.	Solubility in Alcohol.	Solubility in Ether.	M.P. °C.	B.P. °C.	
	h.s.	s.	s.	144.6	d.	1
1.5105/4°	h.s.	s.	s.	174.4		2
	h.s.	s.	s.	186		3
		s.	s.	110—111		4
	a.s.	s.	s.	87		5
	h.s.	s.	s.	124		6
	i.	s.	s.	182		7
1.5105/4°	h.s.	s.	s.	174	subl.	8
	s.	s.	s.	265—266		9
	1 : 3.5	h. 1 : 550		303		10
	del. 1 : 1	s.	i.	184		11
		h.s.	s. ac.	226—228 d.	246.4	12
1.293	1 : 46/18°	h.s.s.		170	d.	13
	1 : 117.5	s.s.		214—215		14
	h.s.	s.	s.	158		15
	h.s.	s.	s.	180		16
	h.s.	s.	s.	175—176		17
1.0414/15°	s.	v.s.	v.s.	41	262.8	18
	i.	s.		45.5	299	19
	h.s.	s.s.	s.	53	302	20
	s.s.	s.	s.	75	354	21
0.983/22°				liq.	210—211	22
0.975/22°	s.s.		s. dil. H_2SO_4	liq.	213—214	23
	i.	v.s.	h.s. C_6H_6	70	330	24
	s.s.	s.s.	i.			25
					134	26
	s.s.	s.	s.	201		27
	h.s.s.		s. fluoresc.			28
	s.d.					29
	h.s.	s.	s.	263 d.		30
	h.s.	v.s.	v.s.	204		31
	h.s.s.	h.s.		235 d.		32
	h.v.s.	v.s.	v.s.	156—157		33
	s.s.	h.s.	v.s.	208		34

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Amino nitro benzoic acid, COOH : NH_2 : NO_2 =1 : 3 : 4	$C_6H_3(NH_2)(NO_2)COOH$	182.10	$C_7H_6O_4N_2$
2 1 : 4 : 3	,, ,,	182.10	,,
3 — — chlor phenol	$C_6H_2OH(NH_2)(NO_2)Cl$	188.52	$C_6H_5O_3N_2Cl$
4 — — phenol NO_2 : OH : NH_2= 6 : 1 : 2	$C_6H_3OH(NO_2)(NH_2)$	154.10	$C_6H_6O_3N_2$
5 3 : 1 : 2	,, ,,	154.10	,,
6 4 : 1 : 2	,, ,,	154.10	,,
7 — phenol, *o*	$NH_2.C_6H_4OH$	109.15	C_6H_7ON
8 — —, *m*	,, ,,	109.15	,,
9 — —, *p*	,, ,,	109.15	,,
10 — propionic acid, *α*	$CH_3.CH(NH_2)COOH$	89.08	$C_3H_7O_2N$
11 — — —, *β*	$CH_2(NH_2)CH_2.COOH$	89.08	,,
12 — purine, 6 (adenine)	$C_5N_5H_5$	135.12	$C_5H_5N_5$
13 — quinoline, *α*	$C_9H_6N(NH_2)$	144.13	$C_9H_8N_2$
14 — —, *β*	,, ,,	144.13	,,
15 — salicylic acid, 1 :2 :5	$NH_2.C_6H_3(OH)COOH$	153.10	$C_7H_7O_3N$
16 — thiazole	$C_3H_2NS.NH_2$	100.13	$C_3H_4N_2S$
17 — thiophen	$C_4H_3S.NH_2$	99.13	C_4H_5NS
18 — thiophenol, *o*	$NH_2.C_6H_4.SH$	125.16	C_6H_7NS
19 — triphenyl methane	$CH(C_6H_5)_2C_6H_4.NH_2$	259.24	$C_{19}H_{17}N$
20 — succinamic acid	$C_2H_3(NH_2)(COOH)CONH_2$	132.10	$C_4H_8O_3N_2$
21 — succinic acid	$C_2H_3(NH_2)(COOH)_2$	133.09	$C_4H_7O_4N$
22 — valeric acid, *α*	$CH_3.CH_2.CH_2.CH(NH_2)$ .COOH	117.12	$C_5H_{11}O_2N$
23 — — —, *γ*	$CH_3.CH(NH_2)CH_2.CH_2$ .COOH	117.12	,,
24 — — —, *δ*	$NH_2.CH_2.CH_2.CH_2.CH_2$ .COOH	117.12	,,
25 — *iso*-valeric acid, *α*	$(CH_3)_2$:$C(NH_2)CH_2.COOH$	117.12	,,
26 — — — —, *β*	$(CH_3)_2$:$CH.CH(NH_2)COOH$	117.12	,,
27 Ammelide	$(CN)_3NH_2(OH)_2$	128.09	$C_3H_4O_2N_4$
28 Ammeline	$(CN)_3(NH_2)_2OH$	127.11	$C_3H_5ON_5$
29 Amygdalic acid	$C_6H_5.CH(COOH).O$ $.C_{20}H_{28}O_{13}$	627.42	$C_{28}H_{35}O_{16}$
30 Amygdalin	$C_6H_5.CH(CN).O.C_{12}H_{21}O_{10}$ $(3H_2O)$	457.33	$C_{20}H_{27}O_{11}N$
31 Amyl alcohol, *norm.*	$C_4H_9.CH_2OH$	88.12	$C_5H_{12}O$

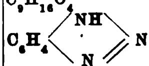
Density $H_2O=1$.	Solubility in Water.	Solubility in Alcohol.	Solubility in Ether.	M.P. °C.	B.P. °C.	
	s.s.	v.s.	s.	298		1
	i.	h.s.s.		277—278		2
				152		3
	h.v.s.	s.	s. $CHCl_3$, C_6H_6	110—111		4
	h.s.	s.	s.	76		5
	h.s.	v.s.	v.s.	89—90		6
	1 : 59/0°	1 : 23	s.	170	subl.	7
	1 : 90/0°	1 : 22/0°		184	subl.	8
	h.s.	s.	s.	122—123		9
	h.v.s.	0.2 : 100	i.	subl. 200	d. 265	10
	v.s.	s.s.		205—206		11
	h.s.	h.s.	i.	d. 360—365		12
	h.s.	h.s.	s.	125		13
	s.	s.	s. ac.	154		14
	s.s.	i.		d. 280		15
	s.s.	s.s.	s.s.	90		16
	v.s.	v.s.	i.			17
				26	234	18
			s.s.	83—84		19
1.519/14°	s.s.	i.	i.	d.		20
1.6613	1 : 222/20°	i.	s.	270—271		21
	s.	s.s.	i.	291.5 d.		22
	v.s.	s.s.	i.	193	d.	23
	v.s.	s.s.	i.	157—158	d.	24
	v.s.	s.s.	i.	217		25
	s.	i.	i.	subl.		26
	h. v.s.s.	i.	s. ac.			27
	i.	i.	s. KOH	d.		28
	del.	i.	i.			29
	8 : 100/10°	h.s.	i.	215 an.		30
0.8121/20°	i.			−134	137.5	31

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Amyl alcohol, *iso.*	$(CH_3)_2:CH.CH_2.CH_2OH$	88.12	$C_5H_{12}O$
2 — —, diethyl carbinol	$(C_2H_5)_2.CHOH$	88.12	,,
3 — —, methyl propyl carbinol	$C_2H_5.CH_2.CHOH.CH_3$	88.12	,,
4 — —, methyl *iso.* propyl carbinol	$(CH_3)_2:CH.CHOH.CH_3$	88.12	,,
5 — —, amylene hydrate	$(CH_3)_2:C(OH).C_2H_5$	88.12	,,
6 — amine, *iso.*	$C_5H_{11}.NH_2$	87.14	$C_5H_{13}N$
7 — anilne, *iso.*	$C_6H_5.NH.C_5H_{11}$	163.20	$C_{11}H_{17}N$
8 — benzene	$C_6H_5.C_5H_{11}$	148.18	$C_{11}H_{16}$
9 — bromide	$C_5H_{11}Br$	151.03	$C_5H_{11}Br$
10 — —, *iso.*	$(CH_3)_2:CH.CH_2.CH_2Br$	151.03	,,
11 — carbylamine	$C_5H_{11}.NC$	97.13	$C_6H_{11}N$
12 — chloride	$C_5H_{11}Cl$	106.57	$C_5H_{11}Cl$
13 — —, *iso.*	$(CH_3)_2:CH.CH_2.CH_2Cl$	106.57	,,
14 — cyanide	$C_5H_{11}.CN$	97.13	$C_6H_{11}N$
15 — dimethyl benzene	$(CH_3)_2:C_6H_3.C_5H_{11}$	176.23	$C_{13}H_{20}$
16 — ether, *iso.*	$(C_5H_{11})_2:O$	155.23	$C_{10}H_{22}O$
17 — ethyl aniline	$C_6H_5.N(C_2H_5)(C_5H_{11})$	191.24	$C_{13}H_{21}N$
18 — — ketone, *iso.*	$C_2H_5.CO.C(C_2H_5)(CH_3)_2$	128.17	$C_8H_{16}O$
19 — iodide	$C_5H_{11}I$	198.13	$C_5H_{11}I$
20 — —, *iso.*	$(CH_3)_2:CH.CH_2.CH_2I$	198.13	,,
21 — mercaptan	$C_5H_{11}.SH$	104.14	$C_5H_{12}S$
22 — methyl benzene, 1:4	$C_5H_{11}.C_6H_4.CH_3$	162.20	$C_{12}H_{18}$
23 — — ether	$C_5H_{11}.O.CH_3$	102.14	$C_6H_{14}O$
24 — nitrate, *iso.*	$C_5H_{11}.O.NO_2$	133.12	$C_5H_{11}O_3N$
25 — nitrite, *iso.*	$C_5H_{11}.O.NO$	117.12	$C_5H_{11}O_2N$
26 — phenol, *iso.*, 1:4	$C_5H_{11}.C_6H_4OH$	164.18	$C_{11}H_{16}O$
27 — sulphide	$(C_5H_{11})_2:S$	174.29	$C_{10}H_{22}S$
28 — thiocyanate, *iso.*	$C_5H_{11}.NCS$	129.19	$C_6H_{11}NS$
29 — urethane	$C_5H_{11}.O.CONH_2$	131.14	$C_6H_{13}O_2N$
30 Amylene, ethyl propylene	$CH_3.CH_2.CH:CH.CH_3$	70.11	C_5H_{10}
31 —, trimethylethylene	$(CH_3)_2:C:CH.CH_3$	70.11	,,
32 —, *iso.*	$(CH_3)_2:CH.CH:CH_2$	70.11	,,
33 — glycol	$C_5H_{10}:(OH)_2$	104.12	$C_5H_{12}O_2$
34 Amyloid	$(C_6H_{10}O_5)x$	(162.11)	
35 Analgene	$C_7H_5O.NH.C_6H_2(OC_2H_5):C_3H_3N$	292.24	$C_{18}H_{16}O_2N_2$
36 Anethole, 1:4	$CH_3.CH:CH.C_6H_4.OCH_3$	148.15	$C_{10}H_{12}O$

$H_2O=1$. Density	Water.	Alcohol.	Ether.	°C. M.P.	°C. B.P.	
	Solubility in					
0.825/0°	1 : 30	s.	s.	-134	131.6	1
0.816/18°	i.	s.		112—113.5	116.3/753mm.	2
0.824/0°	1 : 6			liq.	118.5/753mm.	3
0.819/0°	i.			liq.	112.5	4
0.814/15°	s.s.	s.		-12	101.88	5
0.7503/18°		s.		liq.	95	6
0.928/15°				liq.	259—262	7
0.8602/22°		s.			200.5—201.5/743	8
1.246/0°		s.		liq.	129—130/750	9
1.2358/22°	i.	s.		liq.	120.5—120.8	10
$<H_2O$	i.	s.		liq.	137	11
0.9013/0°		s.		liq.	106	12
0.875/15°	i.	s.		liq.	100.9	13
0.866/20°	s.s.	s.	s.	liq.	144—146	14
				liq.	232—233	15
0.7807/15°	i.			liq.	173	16
				liq.	262	17
0.8502/0°					164—165	18
1.5435/0°		s.		liq.	156	19
1.468/0°		s.		liq.	147	20
0.8548/0°				liq.	116	21
0.8643/0°				liq.	213	22
0.7807/15°				liq.	92	23
1.000/7.5°				liq.	147—148	24
0.902	h.s.s.	s.	s.		97—98	25
	h. v.s.s.			93	265—267	26
0.843/20°		s.s.	s. $CHCl_3$	liq.	213	27
0.9575/0°				liq.	183—184	28
	s.	s.	s.	64.5	220	29
				liq.	39—40	30
0.6783/0°				liq.	36.8/750mm.	31
					21—24	32
0.987/0°	m.	m.	m.	liq.	177	33
	s.s.			42	expl.	34
	i.	c.v.s.s.		206		35
0.989/29°	i.	m.	m.	22.5	232	36

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Angelic acid	$C_4H_7.COOH$	100.09	$C_5H_8O_2$
2 Anhydroformaldehyde aniline	$C_6H_5.N:CH_2$	105.01	C_7H_7N
3 Aniline	$C_6H_5.NH_2$	93.10	C_6H_7N
4 Anisalcohol, *p*	$CH_3O.C_6H_4.CH_2OH$	138.12	$C_8H_{10}O_2$
5 Anisaldehyde, *p*	$CH_3O.C_6H_4.CHO$	136.10	$C_8H_8O_2$
6 Anisic acid	$CH_3O.C_6H_4.COOH$	152.10	$C_8H_8O_3$
7 Anisidine, *o*	$CH_3O.C_6H_4.NH_2$	123.12	C_7H_9ON
8 —, *p*	" "	123.12	"
9 Anisole	$C_6H_5.OCH_3$	108.10	C_7H_8O
10 Anthracene	$C_6H_4:C_2H_2:C_6H_4$	178.20	$C_{14}H_{10}$
11 — carboxylic acid, 9	$C_6H_4:C_2H(COOH):C_6H_4$	222.16	$C_{15}H_{10}O_2$
12 — — —, 1	$C_6H_4:C_2H_2:C_6H_3.COOH$	222.16	"
13 — — —, 2	" "	222.16	"
14 — dihydro	$C_6H_4:C_2H_4:C_6H_4$	180.17	$C_{14}H_{12}$
15 — hexahydro	$C_{14}H_{16}$	184.20	$C_{14}H_{16}$
16 Anthrachrysone	$C_{14}H_4(OH)_4O_2$ 1:3:5:7	272.13	$C_{14}H_8O_6$
17 Anthraflavic acid, 2:6	$OH.C_6H_3:(CO)_2:C_6H_3.OH$	240.13	$C_{14}H_8O_4$
18 Anthragallol, 1:2:3	$C_6H_4:(CO)_2:C_6H(OH)_3$	256.13	$C_{14}H_8O_5$
19 Anthramine	$C_6H_4:C_2H_2:C_6H_3.NH_2$	193.17	$C_{14}H_{11}N$
20 Anthranil		119.09	C_7H_5ON
21 Anthranol		194.15	$C_{14}H_{10}O$
22 Anthrapurpurin	$OH.C_6H_3:(CO)_2:C_6H_2:(OH)_2$	256.13	$C_{14}H_8O_5$
23 Anthraquinoline		229.18	$C_{17}H_{11}N$
24 Anthraquinone	$C_6H_4:(CO)_2:C_6H_4$	208.13	$C_{14}H_8O_2$
25 Anthrarufin, 1:5	$OH.C_6H_3:(CO)_2:C_6H_3.OH$	240.13	$C_{14}H_8O_4$
26 Anthrol	$C_6H_4:C_2H_2:C_6H_3.OH$	194.15	$C_{14}H_{10}O$
27 Antimony penta-methyl	$Sb(CH_3)_5$	193.35	$C_5H_{15}Sb$
28 — tri-ethyl	$Sb(C_2H_5)_3$	207.35	$C_6H_{15}Sb$
29 — trimethyl	$Sb(CH_3)_3$	165.29	C_3H_9Sb
30 Antipyrine, 1-phenyl 2:3-dimethyl-pyrazolone		188.17	$C_{11}H_{12}ON_2$

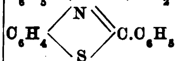
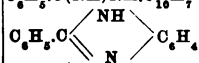
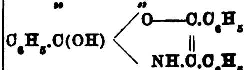
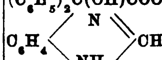
$H_2O=1$. Density	Water.	Alcohol.	Ether.	°C. M.P.	°C. B.P.	
	——Solubility in——					
	h.v.s.	s.	s.		185	1
	i.	v.s.s.	s.s.	120		2
1.023/15°	3 : 100	v.s.	v.s.	−6.2	184.4	3
1.11/26°				45	258.8	4
1.1228/18°	s.s.	m.	m.	0	248	5
1.38/4°	v.s.s.	s.	s.	184.2	275—280	6
1.108/26°		s.	s. ac.	2.5	218	7
1.0711/55°		s.	s. ac.	57.2	239.5/755mm.	8
1.0124/0°	i.	s.	s.	−37.8	153.8	9
1.147	i.	s.s.	s.s.	216.6	351	10
	h.s.s.	s.		206 d.		11
	i.	s.	s.s.	260	subl.	12
		s.s.	s. acetic	>280	subl.	13
	i.	s.	s.	104—105	313	14
	i.	s.	s.	63	290	15
	i.	s.	s.s	>360		16
	i.	v.s.s.	i.	>330	subl. d.	17
	s.s.			310	subl. 290	18
	v.s.s.	s.s.	s.s	238		19
	h.s.	s.	s.		210—215 d.	20
		s.	s.h. alk.	163—170 d.		21
	h.s.s.	s.	s.s., s. alk.	369	462	22
	i.	s.	s.	170	446	23
1.425	i.	s.s.	s.s.	277	379—381	24
	s.s.	s.s.	s. C_6H_6	280		2
	v.s.s.	v.s.	s. acetone	d. 250		26
	i.			96—100		27
1.324	i.	s.	s.	liq.	158.5	28
1.523/15°	s.s.	i.	s.	liq.	80.6	29
	s.	s.	s.s.	114	309/174mm.	30

	Name.	Formula.	Formula Weight.	Empirical Formula.
1	Aposafranone, see	Benzene indone		
2	Arabin	$C_{10}H_{18}O_9$	282.19	$C_{10}H_{18}O_9$
3	Arabinose, l.	$C_4H_5(OH)_4CHO$	150.11	$C_5H_{10}O_5$
4	Arabite, l.	$C_5H_7(OH)_5$	152.12	$C_5H_{12}O_5$
5	Arabonic acid, l.	$CH_2OH(CHOH)_3COOH$	166.11	$C_5H_{10}O_6$
6	Arachidic acid	$C_{20}H_{40}O_2$	312.42	$C_{20}H_{40}O_2$
7	Arbutine	$2C_{12}H_{16}O_7.H_2O$	562.40	$C_{12}H_{16}O_7$
8	Arsenic di-ethyl	$As(C_2H_5)_2$	133.06	$C_4H_{10}As$
9	— dimethyl	$As(CH_3)_2$	105.02	C_2H_6As
10	— trimethyl	$As(CH_3)_3$	120.05	C_3H_9As
11	Asparagine, see	Amino succinamic acid		
12	Atrolactic acid	$2CH_3.C(C_6H_5)(OH)COOH.H_2O$	350.27	$C_9H_{10}O_3$
13	Atropic acid	$CH_2:C(C_6H_5)COOH$	148.11	$C_9H_8O_2$
14	Auramine	$C_{17}H_{21}N_3$	267.28	$C_{17}H_{21}N_3$
15	Aurine, Corraline	$(C_6H_4OH)_2:C:C_6H_4:O$	290.21	$C_{19}H_{14}O_3$
16	Azelaïc acid	$C_9H_{16}O_4$	188.17	$C_9H_{16}O_4$
17	Aziminobenzene		119.10	$C_6H_5N_3$
18	Azobenzene	$C_6H_5.N:N.C_6H_5$	182.16	$C_{12}H_{10}N_2$
19	Azobenzoic acid, *o*	$C_{14}H_{10}N_2O_4$	270.17	$C_{14}H_{10}O_4N_2$
20	— —, *m*	$2C_{14}H_{10}N_2O_4.H_2O$	558.36	,,
21	— —, *p*	,, ,,	558.36	,,
22	Azodicarbonamide	$NH_2.CO.N_2.CONH_2$	116.08	$C_2H_4O_2N_4$
23	Azonaphthalene, 2 : 2′	$(C_{10}H_7)_2N_2$	282.23	$C_{20}H_{14}N_2$
24	—, 1 : 1′	,, ,,	282.23	,,
25	—, 1 : 2′	,, ,,	282.23	,,
26	Azophenol, *o*	$(C_6H_4OH)_2N_2$	214.16	$C_{12}H_{10}O_2N_2$
27	—, *p*	,, ,,	214.16	,,
28	Azophenetole, *o*	$(C_6H_4.OCH_3)_2N_2$	246.23	$C_{14}H_{18}O_2N_2$
29	—, *p*	,, ,,	246.23	,,
30	Azophenylene, see	Phenazine		
31	Azotoluene, 2 : 2′	$(C_7H_7)_2N_2$	210.20	$C_{14}H_{14}N_2$
32	—, 3 : 3′	,, ,,	210.20	,,
33	—, 4 : 4′	,, ,,	210.20	,,
34	Azoxybenzene	$(C_6H_5)_2N_2O$	198.16	$C_{12}H_{10}ON_2$
35	Azoxybenzoic acid, *o*	$C_{14}H_{10}N_2O_5$	286.17	$C_{14}H_{10}O_5N_2$
36	— —, *m*	,, ,,	286.17	,,
37	— —, *p*	,, ,,	286.17	,,

$H_2O=1$. Density	Water.	Alcohol. Solubility in	Ether.	°C. M.P.	°C. B.P.	
						1
	v.s.	v.s.s.				2
	s.	i.	i.	160		3
	h.s.			102		4
	s.			89		5
				77.5	238	6
	h.v.s.	s.s.	i.	195		7
$>H_2O$	i.	s.	s.	liq.	185—190	8
1.15/15°				liq.	149	9
				liq.	<100	10
						11
	h.m.			93—94		12
	1 :692/19°		s. CS_2	106.5	267 d.	13
	i.	s.s.	i.	136		14
	i.	s.	s. alk.	d. 220		15
	h.v.s.	v.s	v.s.	106	360	16
1.18—1.23		s.	s. C_6H_6	98.5		17
1.203	i.	s.	s.	68	297	18
	v.s.s.	s.		d. 237		19
	s.s.	s.s.	s.s.		d.	20
	i.	i.	i.		d.	21
	v.s.s.	i.		d. 180		22
	i.	s.s.	s. acetic	204		23
	i.		s. acetic	190		24
	i.		s. acetic	136		25
	i.	1 : 300	v.s. KOH	171	subl.	26
	s.s.	s.	s., s. C_6H_6	216—218		27
	i.	s.	s., s. HCl	131	d. 240	28
	i.	h.s.	v.s.	167		29
						30
	i.	s.	s., s. C_6H_6	55		31
	i.	s.	s.	54—55		32
	i.	s.s.	s.	144		33
1.246/20°	i.	s	s.	36	d.	34
	s.s.	h.s.	s.s..	254—255		35
	i.	s.s.	s.s..	345		36
	i.	i.	s. C_5H_5N	d. 240		37

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Azoxynaphthalene, 1:1'	$(C_{10}H_7)_2N_2O$	298.23	$C_{20}H_{14}ON_2$
2 —, 2:2'	,, ,,	298.23	,,
3 Barbituric acid, see	Malonyl urea		
4 Bassorin	$C_6H_{10}O_5$	162.11	$C_6H_{10}O_5$
5 Behenic acid	$CH_3(CH_2)_{20}COOH$	340.46	$C_{22}H_{44}O_2$
6 Behenolic acid	$C_{22}H_{40}O_2$	336.43	$C_{22}H_{40}O_2$
7 Benzal acetone	$C_6H_5.C_2H_2.CO.CH_3$	146.13	$C_{10}H_{10}O$
8 — acetophenone	$C_6H_5.C_2H_2.CO.C_6H_5$	208.17	$C_{15}H_{12}O$
9 — acetoacetic ester	$CH_3CO.C:CH.C_6H_5$ $COOC_2H_5$	218.18	$C_{13}H_{14}O_3$
10 — azine	$C_6H_5.CH:N.N:CH.C_6H_5$	208.19	$C_{14}H_{12}N_2$
11 — chloride	$C_6H_5.CHCl_2$	161.00	$C_7H_6Cl_2$
12 — cyanhydrin	$C_6H_5.CH(OH)CN$	133.11	C_8H_7ON
13 — hydrazine	$C_6H_5CH:N.NH_2$	120.12	$C_7H_8N_2$
14 — malonic acid	$C_6H_5.CH:C:(COOH)_2$	192.11	$C_{10}H_8O_4$
15 — phenylhydrazone	$C_6H_5.CH:N.NH.C_6H_5$	196.18	$C_{13}H_{12}N_2$
16 Benzaldehyde	$C_6H_5.CHO$	106.08	C_7H_6O
17 — sulphonic acid, o	$CHO.C_6H_4.SO_3H$	186.14	$C_7H_6O_4S$
18 Benzaldoxime, *anti*	$C_6H_5.CH:N.OH$	121.10	C_7H_7ON
19 —, *syn.*	,, ,,	121.10	,,
20 — carboxylic acid anhydride	C_6H_4 $<$ $CO.O$ | $CH:N$	147.09	$C_8H_5O_2N$
21 Benzamarone	$C_6H_5CH(C_6H_5).CO.C_6H_5$ $C<$ $CH(C_6H_5)CO.C_6H_5$	480.40	$C_{35}H_{28}O_2$
22 Benzamide	$C_6H_5.CO.NH_2$	121.10	C_7H_7ON
23 Benzamidine	$C_6H_5.C(NH)NH_2$	120.12	$C_7H_8N_2$
24 Benzanilide	$C_6H_5.CONH.C_6H_5$	197.16	$C_{13}H_{11}ON$
25 Benzaurine	$C_6H_5.C:C_6H_4:O$ C_6H_4OH	274.21	$C_{19}H_{16}O_3$
26 Benzene	C_6H_6	78.06	C_6H_6
27 — hexachloride	$C_6H_6Cl_6$	290.84	$C_6H_6Cl_6$
28 — indone	$C_{18}H_{12}N_2O$	272.21	$C_{18}H_{12}ON_2$
29 — pentacarboxylic acid	$C_6H(COOH)_5.5H_2O$	388.18	$C_{11}H_6O_{10}$
30 — sulphamide	$C_6H_5.SO_2.NH_2$	157.16	$C_6H_7O_2NS$
31 — sulphinic acid	$C_6H_5.SO_2H$	142.14	$C_6H_6O_2S$
32 — sulphochloride	$C_6H_5.SO_2Cl$	176.59	$C_6H_5O_2SCl$
33 — sulphonic acid	$C_6H_5SO_3H.H_2O$	176.16	$C_6H_6O_3S$

Density $H_2O=1$.	Water.	Alcohol.	Ether.	°C. M.P.	°C. B.P.	
	Solubility in					
	i.	i.	i., s. $CHCl_3$	127		1
	i.	i.	i.	167—168		2
						3
	s.s.	i.				4
	i.	s. (abs.)		83		5
	i.	v.s.		57.5		6
1.008	i.	s.	s.	41—42	260—262	7
	i.	s.	s.	62	345—348	8
		s.		59—60	181/17mm.	9
	i.	h.v.s.	v.s.	93	d.	10
1.295/16°				−16.1	203.5	11
1.124	i.	s.	s.	S.P. −10	d 170	12
		s.	s.	16	140/14mm.	13
	s.s.	h.s.	s.s.	d. 195—196		14
		h.s.	s.s.	156	235—239/55	15
1.0455/20°	1 : 300	s.		−26	179.5	16
	s.			114		17
1.11/20°	s.s.	v.s.	v.s.	20.5	152—153/53	18
			v.s.	128—130		19
				145 becomes $C_6H_4(CN)COOH$		20
	1 : 157 h.	s.s.	s.s. C_6H_6	219, *iso* 180		21
1.341/4°	s.s.	s.	s.	130	290	22
	s.	v.s.	s.s.	75—80		23
1.31/4°	i.	s.	s.s.	164		24
	i.	s.	s.	100		25
0.87907/20°	0.2 : 100	s.	s.	5.4	80.2	26
1.87/20°		s. $CHCl_3$	s. C_6H_6	157	288	27
	s.s.	s.	s. C_6H_6	284—249		28
	v.s.			d.		29
	s.s.	h.v.s.	s.	141 d.		30
	h.s.	s.	s.	83—84	d. 100	31
1.3830/15°	i.	s.	s.	14.5	d. 247	32
	v.s.	v.s.	i.	65—66	135—137	33

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Benzene trisulphonic acid	$C_6H_3(SO_3H)_3$	318.26	$C_6H_6O_9S_3$
2 Benzenyl amidoxime	$C_6H_5.C(:NOH)NH_2$	136.20	$C_7H_8ON_2$
3 — amido thiophenol		211.21	$C_{13}H_9NS$
4 — naphthylamidine	$C_6H_5.C(NH)NH.C_{10}H_7$	246.22	$C_{17}H_{14}N_2$
5 — phenyleneamidine		194.17	$C_{13}H_{10}N_2$
6 Benzhydrol	$(C_6H_5)_2:CHOH$	184.16	$C_{13}H_{12}O$
7 — ether	$[(C_6H_5)_2:CH]_2O$	350.31	$C_{26}H_{22}O$
8 Benzhydroxamic acid	$C_6H_5.C(:NOH)OH$	137.11	$C_7H_7O_2N$
9 Benzhydryl amine	$(C_6H_5)_2:CH.NH_2$	183.18	$C_{13}H_{13}N$
10 — benzoic acid, *p*	$C_6H_5.CH(OH)C_6H_4.COOH$	228.17	$C_{14}H_{12}O_3$
11 Benzidine, *p*	$NH_2.C_6H_4.C_6H_4.NH_2$	184.18	$C_{12}H_{12}N_2$
12 — disulphonic acid, *o*	$(NH_2)_2C_{12}H_6(SO_3H)_2$	344.30	$C_{12}H_{12}O_6N_2S_2$
13 — sulphone	$C_{12}H_6(NH_2)_2SO_2$	246.22	$C_{12}H_{10}O_2N_2S$
14 Benzil	$C_6H_5.CO.CO.C_6H_5$	210.15	$C_{14}H_{10}O_2$
15 — dioxime,	$C_6H_5.C(NOH).C(NOH)C_6H_5$	240.19	$C_{14}H_{12}O_2N_2$
16 — —, *β*	,, ,,	240.19	,,
17 — —, *γ*	,, ,,	240.19	,,
18 — monoxin	$C_6H_5.CO.C(NOH)C_6H_5$	225.17	$C_{14}H_{11}O_2N$
19 — —, *γ*	,, ,,	225.17	,,
20 — imide		315.25	$C_{21}H_{17}O_2N$
21 — osazone	$C_6H_5.C:N.NH.C_6H_5$ $C_6H_5.C:N.NH.C_6H_5$	390.35	$C_{26}H_{22}N_4$
22 Benzilic acid	$(C_6H_5)_2C(OH)COOH$	228.17	$C_{14}H_{12}O_3$
23 Benzimidazole, *o*		118.10	$C_7H_6H_2$
24 Benzimidazolone, *o*	$C_6H_4:(NH)_2:CO$	134.10	$C_7H_6ON_2$
25 Benzoic acid	$C_6H_5.COOH$	122.08	$C_7H_6O_2$
26 Benzoate, calcium	$(C_6H_5COO)_2Ca(.3H_2O)$	282.22	$C_{14}H_{10}O_4Ca$
27 —, ferric, basic	$(C_6H_5COO)_3Fe_2(OH)_3$	525.93	$C_{21}H_{18}O_9Fe_2$
28 —, sodium	$C_6H_5.COONa(,H_2O)$	144.08	$C_7H_5O_2Na$
29 —, allyl	$C_6H_5.COOC_3H_5$	162.13	$C_{10}H_{10}O_2$
30 —, amyl *iso*	$C_6H_5.COOC_5H_{11}$	192.19	$C_{12}H_{16}O_2$

Density $H_2O=1$.	Water.	Alcohol.	Ether.	°C. M.P.	°C. B.P.	
	Solubility in					
	del.					1
	h.s.	s.	s.	88		2
	i.	s.	s.	115	360	3
	i.	s.		141		4
	s.s.	s.	s. acetic	280		5
	1 :2000/20°	v.s.	v.s.	69	297—298/748	6
		s.s.	s. C_6H_6	109	267/15mm.	7
	1 :44.5/6°	v.s.	s.s.	124—125		8
				34—35	302.6	9
	h.s.	s.	s.	164—165	d.	10
	c.s.s.	s.	s.	128	400/740mm.	11
	s.s.	v.s.s.	v.s.s.			12
	i.	i.	i.	>350		13
	i.	s.	s.	95	347	14
	i.	s.s.	s.s.	237 d.		15
	h.s.s.	s.	s.	206—207 d.		16
	i.	v.s.	s.	165		17
	s.s.	v.s.	v.s.	137—138		18
	i.	v.s.	s.	114		19
		s.		137—138		20
	i.	s.s.	s.s.	225		21
	c.s.s.	s.	s.	150		22
	s.	s.	s. ac., alk.	170		23
	h.s.s.	s.		312		24
1.337	0.29 :100/20°	s.	s.	121—122	249.2	25
1.435—1.475	1 : 27.7/5°					26
	i.					27
	v.s.	1 : 13				28
					230/768mm.	29
1.004/0°					262	30

	Name.	Formula.	Formula Weight.	Empirical Formula.
1	Benzoate, benzyl	$C_6H_5.COOCH_2.C_6H_5$	212.17	$C_{14}H_{12}O_2$
2	—, ethyl	$C_6H_5.COOC_2H_5$	150.13	$C_9H_{10}O_2$
3	—, ethylene	$(C_6H_5.COO)_2C_2H_4$	270.19	$C_{16}H_{14}O_4$
4	—, methyl	$C_6H_5.COOCH_3$	136.10	$C_8H_8O_2$
5	Benzoic anhydride	$(C_6H_5.CO)_2:O$	226.15	$C_{14}H_{10}O_3$
6	Benzoïn, d., l.	$C_6H_5.CH(OH)CO.C_6H_5$	212.17	$C_{14}H_{12}O_2$
7	—, r.	,, ,,	212.17	,,
8	Benzo nitrile	$C_6H_5.CN$	103.09	C_7H_5N
9	— phenone	$(C_6H_5)_2:CO$	182.15	$C_{13}H_{10}O$
10	— — dicarboxylic acid, 2 : 2′	$(C_6H_4.COOH)_2:CO$	270.16	$C_{15}H_{10}O_5$
11	— — oxime	$(C_6H_5)_2:C:NOH$	197.16	$C_{13}H_{11}ON$
12	— trichloride	$C_6H_5.CCl_3$	195.46	$C_7H_5Cl_3$
13	Benzophosphinic acid	$COOH.C_6H_4.PO(OH)_2$ (*p*)	202.13	$C_7H_7O_5P$
14	Benzoxazole	$C_6H_4\left\langle {O \atop N} \right\rangle CH$	119.09	C_7H_5ON
15	Benzoyl acetic acid	$C_6H_5CO.CH_2COOH$	164.11	$C_9H_8O_3$
16	— acetone	$C_6H_5CO.CH_2COCH_3$	162.13	$C_{10}H_{10}O_2$
17	— acetonitrile	$C_6H_5CO.CH_2CN$	145.11	C_9H_7ON
18	— azide	$C_6H_5CO.N\left\langle {N \atop \Vert \atop N} \right.$	147.11	$C_7H_5ON_3$
19	— benzoic acid, *o*	$C_6H_5CO.C_6H_4COOH.H_2O$	244.22	$C_{14}H_{10}O_3$
20	— — —, *m*	$C_6H_5CO.C_6H_4COOH$	226.15	,,
21	— — —, *p*	,, ,,	226.15	,,
22	— bromide	$C_6H_5CO.Br$	185.00	C_7H_5OBr
23	— chloride	$C_6H_5CO.Cl$	140.54	C_7H_5OCl
24	— cyanide	$C_6H_5CO.CN$	131.09	C_8H_5ON
25	— *cyclo*-butane	$C_6H_5CO.CH:(CH_2):CH_2$	160.15	$C_{11}H_{12}O$
26	— *cyclo*-propane	$C_6H_5CO.CH\left\langle {CH_2 \atop \vert \atop CH_2} \right.$	146.13	$C_{10}H_{10}O$
27	— fluoride	$C_6H_5CO.F$	124.08	C_7H_5OF
28	— formic acid	$C_6H_5CO.COOH$	150.09	$C_8H_6O_3$
29	— glycollic acid	$C_6H_5CO.OCH_2.COOH$	180.11	$C_9H_8O_4$
30	— hydrazine	$C_6H_5CO.NH.NH_2$	136.20	$C_7H_8ON_2$
31	— hydrogen peroxide	$C_6H_5CO.O_2H$	138.08	$C_7H_6O_3$
32	— iodide	$C_6H_5CO.I$	232.00	C_7H_5OI
33	— lactic acid	$CH_3.CH(O.C_6H_5.CO).COOH$	194.13	$C_{10}H_{10}O_4$

Density H_2O=1.	Solubility in Water.	Solubility in Alcohol.	Solubility in Ether.	M.P. °C.	B.P. °C.	
1.114/18°		s.		$<$20	315—320	1
1.0502/16°	h.s.s.	s.	s.	-34.2	212.9/745.5mm.	2
	i.		s.	73—74	$>$360	3
1.1026/0°	i.			liq.	199.2/746mm.	4
.9555/14.9°	i.	s.	s.	42	360	5
	h.s.s.	s.	s.	131—132.5		6
				129—130		7
1.0052/18°	1 : 100 h.	m.	m.	-17	191.3	8
1.098/50°	i.	s.	s.	47.2		9
	s.s.	s.	s.	$>$300		10
	i.	s.	s. alk.	139		11
1.38/14°	d.		s.	-21.2	213—214	12
	s.	s.	i.	$>$300		13
	i.			30.5	182.5	14
	s.s.	v.s.	v.s.	104 d.		15
1.0899/60°	s.s.	v.s.	v.s.	61	260—261	16
		s.	s.	80.5		17
	i.	v.s.	v.s.	29—30		18
	h.s.			120		19
	s.s.	v.s.	v.s.	161—162		20
	s.s.	s.	s.	194	subl.	21
1.570/15°		s.		liq.	218—219	22
1.2122/20°	d.	d.	d.	-1	198.3/749mm.	23
	d.			32	205—208 d.	24
1.06/4°					258—259/740	25
					239—239.5/720	26
$>H_2O$				liq.	154	27
	s.	s.	s.	65		28
	h.s	s.	s.			29
	v.s.	v.s.	s.s.	112.5		30
	i.	s.	s.	41—43	97- 110/15mm.	31
	d.	s.		3	135/25mm.	32
	h.s.	s.	s.	112		33

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Benzoyl peroxide	$(C_6H_5CO)_2O_2$	242.15	$C_{14}H_{10}O_4$
2 — phthalic acid, 1:2:3	$C_6H_5CO.C_6H_3(COOH)_2$	270.16	$C_{15}H_{10}O_5$
3 — — —, tere, 1:2:5	,, ,,	270.16	,,
4 — propionic acid, β	$C_6H_5CO.CH_2.CH_2.COOH$	178.13	$C_{10}H_{10}O_3$
5 — pyrocatechol, see	Dihydroxy benzophenone		
6 — salicin, see	Populin		
7 — sulphide	$(C_6H_5CO)_2:S$	242.21	$C_{14}H_{10}O_2S$
8 — thiourea	$C_6H_5CO.NH.CS.NH_2$	180.18	$C_8H_8ON_2S$
9 — toluidine, *o*	$C_6H_5CO.NH.C_6H_4CH_3$	211.18	$C_{14}H_{13}ON$
10 — —, *p*	,, ,,	211.18	,,
11 — urea	$C_6H_5CO.NH.CO.NH_2$	164.12	$C_8H_8O_2N_2$
12 Benzpinacone	$(C_6H_5)_2COH.COH:(C_6H_5)_2$	366.31	$C_{26}H_{22}O_2$
13 Benzyl acetamide	$C_6H_5.CH_2NH(CH_3.CHO)$	150.15	$C_9H_{12}ON$
14 — alcohol	$C_6H_5.CH_2OH$	108.10	C_7H_8O
15 — amine	$C_6H_5.CH_2.NH_2$	107.18	C_7H_9N
16 — aniline	$C_6H_5.CH_2.NH.C_6H_5$	183.18	$C_{13}H_{13}N$
17 — azide	$C_6H_5.CH_2.N_3$	133.12	$C_7H_7N_3$
18 — benzoic acid, *o*	$C_6H_5.CH_2.C_6H_4.COOH$	212.17	$C_{14}H_{12}O_2$
19 — — —, *p*	,, ,,	212.17	,,
20 — bromide	$C_6H_5.CH_2.Br$	171.01	C_7H_7Br
21 — carbamate	$C_6H_5.CH_2.CO_2.NH_2$	151.12	$C_8H_9O_2N$
22 — chloride	$C_6H_5.CH_2.Cl$	126.55	C_7H_7Cl
23 — cyanide	$C_6H_5.CH_2.CN$	117.11	C_8H_7N
24 — cyanamide	$C_6H_5.CH_2.NH.CN$	132.12	$C_8H_8N_2$
25 — cyanurate	$(C_6H_5.CH_2.N.CO)_3$	399.32	$C_{24}H_{21}O_3N_3$
26 — diphenyl, *o*	$C_6H_5.CH_2.C_6H_4.C_6H_5$	244.22	$C_{19}H_{16}$
27 — —, *p*	,, ,,	244.22	,,
28 — diphenylamine	$C_6H_5.CH_2.N:(C_6H_5)_2$	259.24	$C_{19}H_{17}N$
29 — disulphide	$(C_6H_5.CH_2)_2S_2$	246.30	$C_{14}H_{14}S_2$
30 — ether	$(C_6H_5.CH_2)_2O$	198.18	$C_{14}H_{14}O$
31 — ethyl benzene	$C_6H_5.CH_2.C_6H_4.C_2H_5$	196.20	$C_{15}H_{16}$
32 — — ether	$C_6H_5.CH_2.O.C_2H_5$	136.14	$C_9H_{12}O$
33 — hydrazine	$C_6H_5.CH_2.NH.NH_2$	122.14	$C_7H_{10}N_2$
34 — hydroxylamine, *a*	$C_6H_5.CH_2.NH.OH$	123.12	C_7H_9ON
35 — —, β	,, ,,	123.12	,,
36 — iodide	$C_6H_5.CH_2I$	208.01	C_7H_7I
37 — mercaptan	$C_6H_5.CH_2.SH$	124.16	C_7H_8S
38 — naphthalene, *a*	$C_6H_5.CH_2.C_{10}H_7$	218.20	$C_{17}H_{14}$
39 — —, β	,, ,,	218.20	,,
40 — naphthyl ketone	$C_6H_5.CH_2.CO.C_{10}H_7$	268.23	$C_{18}H_{14}O$

Density $H_2O=1$.	Solubility in— Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
	i.	s. C_6H_6	s.	104		1
	h.s.	s.		155		2
	i.	s.	s.	>290		3
	h.s.	v.s.	v.s.	116		4
						5
						6
	i.	s.s.	s.	129	d.	7
	s.	s.	i.	71		8
	h.s.s.	s.		131		9
		v.s.	s.	158	232	10
	s. KOH	h. 1 : 24	i.	215		11
		h. 1 : 39	s.	185—186		12
	i.	v.s.	v.s.	60—61	>300	13
1.043/20°	i.	s.	s.	liq.	206.5	14
0.9826/18.9°	m.	m.	m.	liq.	183	15
		s.		35.5	298—300	16
	i.	m.	m.		108/25mm.	17
	s.s.	s.	s.	114	subl. 307	18
	s.s.	v.s.	v.s.	154—155	315.5—316	19
1.4380/21°	s.s.	v.s.	v.s.		198—199	20
	s.s.	s.	s.	86	d.	21
1.107/14°	i.	s.	s.	-41.3	179	22
1.0146/18°	i.	s.		-24.6	231.7	23
	i.	s.	s.	33		24
	i.	s.	s.s.	157		25
		v.s.	v.s.	54	283—287/650	26
		s.	v.s.	85	285—286/650	27
		c.s.s.		87		28
		h.s.	s.	71—72		29
1.0359/16°				oil	296	30
0.985/19°	s. $CHCl_3$	s.	s.		294—295	31
		s.			189	32
	s.				135/29mm.	33
					123/50mm.	34
	s.			57		35
1.7335/25°			s.s. CS_2	23	d.	36
1.058/20°				liq.	195	37
1.165/0°		h. 1 : 30	1 : 2	58.6	350	38
1.176		1 : 44	s. C_6H_6	35.5	350	39
		s.	s.	57		40

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Benzyl phenanthrene	$C_6H_5.CH_2.C_6H_3:C_2H_2:C_6H_4$	268.23	$C_{21}H_{16}$
2 — phenol, *p*	$C_6H_5.CH_2.C_6H_4OH$	184.16	$C_{13}H_{12}O$
3 — pyridine, *a*	$C_6H_5.CH_2.C_5H_4N$	169.16	$C_{12}H_{11}N$
4 — —, *β*	„ „	169.16	„
5 — sulphide	$(C_6H_5.CH_2)_2S$	214.24	$C_{14}H_{14}S$
6 — sulphone	$(C_6H_5.CH_2)_2SO_2$	246.24	$C_{14}H_{14}O_2S$
7 — sulphoxide	$(C_6H_5.CH_2)_2SO$	230.24	$C_{14}H_{14}OS$
8 — tartaric acid	$C_6H_5.CH_2.C(OH)COOH$ $CH(OH)COOH$	240.15	$C_{11}H_{12}O_6$
9 — thiocyanate	$C_6H_5.CH_2.SCN$	149.11	C_8H_7NS
10 — *iso*-thiocyanate	$C_6H_5.CH_2.NCS$	149.11	„
11 — thiourea	$C_6H_5.CH_2.NH.CS.NH_2$	166.20	$C_8H_{10}N_2S$
12 — toluene, *m*	$C_6H_5.CH_2.C_6H_4.CH_3$	182.18	$C_{14}H_{14}$
13 — —, *p*	„ „	182.18	„
14 — urea	$C_6H_5.CH_2.NH.CO.NH_2$	150.14	$C_8H_{10}ON_2$
15 Benzylidine acetone	$C_6H_5.C_2H_2.COCH_3$	146.13	$C_{10}H_{10}O$
16 — aniline	$C_6H_5.CHN(C_6H_5)$	181.16	$C_{13}H_{11}N$
17 — bromide	$C_6H_5.CHBr_2$	249.94	$C_7H_6Br_2$
18 — diacetate	$C_6H_5.CH:(CH_3COO)_2$	208.18	$C_{11}H_{12}O_4$
19 — phenylhydrazine	$C_6H_5.CH:N.NH.C_6H_5$	208.15	$C_{13}H_{12}N_2$
20 — phthalide	$C_6H_4.C:CH.C_6H_5$ $CO—O$	222.16	$C_{15}H_{10}O_2$
21 Berberonic acid	$C_5H_2N(COOH)_3+H_2O$	229.11	$C_8H_5O_6N$
22 Betaïne	$N(CH_3)_3.CH_2.CO\ (+H_2O)$	101.12	$C_5H_{11}ON$
23 Bilirubin	$C_{32}H_{36}N_4O_6$	572.49	$C_{32}H_{36}O_6N_4$
24 Biliverdin	$C_{32}H_{36}N_4O_8$	604.49	$C_{32}H_{36}O_8N_4$
25 Bismuth tri-ethyl	$Bi(C_2H_5)_3$	295.15	$C_6H_{15}Bi$
26 Biuret	$NH:(CONH_2)_2$	103.08	$C_2H_5O_2N_3$
27 Borneol	$C_{10}H_{18}O$	154.19	$C_{10}H_{18}O$
28 Bornyl amine	$C_{10}H_{17}NH_2$	153.21	$C_{10}H_{19}N$
29 — chloride	$C_{10}H_{17}Cl$	172.65	$C_{10}H_{17}Cl$
30 Boron etho-diethoxide	$C_2H_5B:(OC_2H_5)_2$	130.15	$C_6H_{15}O_2B$
31 Brasileïn	$C_{16}H_{12}O_5$	302.20	$C_{16}H_{12}O_5$
32 Brasilin	$C_{16}H_{14}O_5$	304.21	$C_{16}H_{14}O_5$
33 Brassylic acid, *a β*	$C_9H_{18}(COOH)_2$	216.22	$C_{11}H_{20}O_4$
34 Bromo-acetamide	$CH_3.CO.NHBr$	137.97	C_2H_4ONBr
35 — acetic acid	$CH_2Br.COOH$	138.95	$C_2H_3O_2Br$
36 — acetophenone	$C_6H_5.CO.CH_2Br$	199.02	C_8H_7OBr

Density $H_2O=1$.	Solubility in Water.	Solubility in Alcohol.	Solubility in Ether.	M.P. °C.	B.P. °C.	
		s.s.	s. C_6H_6	155—156		1
	s. alk.	s.		84	320—322	2
					276/742mm.	3
				34	287/740mm.	4
	i.	s.	s.	49—50	170—175/13mm.	5
		c.s.s.	s. C_6H_6	150		6
	h.s.	s.	s.	133		7
	s.	s.		143 d.		8
	i.	v.s.	v.s.	40—42	230—235	9
$>H_2O$	i.			liq.	240—245	10
	s.			103—104		11
0.997/17.5°		s.	s.	liq.	268—269.5/20	12
0.995/17.5°		s.	s.	−20	278—280	13
	h.s.	s.		150.5—151.5	d.	14
1.008		s.	s.	41—42	260—262	15
	i.	v.s.	v.s.	50	300	16
					130—140/20	17
		v.s.	v.s.	45	220	18
		h.s.	s.s.	156		19
	i.	h.s.		99, *iso* 91		20
	h.s.	h.s.s.	i.	235		21
	61.8 : 100 /25°	s.	i.			22
	i.	v.s.s.	v.s.s.	192—192.5		23
	i.	s.	s.s.			24
2.3/18°	i.	s.	s.	liq.	107	25
	s.	s.		190 d.		26
1.011	i.	s.	s.	205	212	27
	s.s.	v.s.	v.s.	159—160		28
	d. 40°	v.s.	v.s.	158		29
	d.				125	30
	s. alk.	s.				31
	s.	s.	s.			32
	s.s.			90—91		33
	s.	s.	i.	91		34
	s.			49—50	208	35
		v.s.	v.s.	51		36

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Bromo acetylene	C_2HBr	104.94	C_2HBr
2 — allyl alcohol	$CH_2:CBr.CH_2OH$	136.98	C_3H_5OBr
3 — aniline, *o*	$Br.C_6H_4.NH_2$	172.01	C_6H_6NBr
4 — —, *m*	,, ,,	172.01	,,
5 — —, *p*	,, ,,	172.01	,,
6 — anthraquinone, 1	$C_6H_4:(CO)_2:C_6H_3Br$	287.05	$C_{14}H_7O_2Br$
7 — —. 2	,, ,,	287.05	,,
8 — benzene	$C_6H_5.Br$	156.09	C_6H_5Br
9 — benzoic acid, *o*	$Br.C_6H_4.COOH$	201.00	$C_7H_5O_2Br$
10 — — —, *m*	,, ,,	201.00	,,
11 — — —, *p*	,, ,,	201.00	,,
12 — camphor	$C_{10}H_{15}OBr$	231.09	$C_{10}H_{15}OBr$
13 — cinnamic acid, *a*	$C_6H_5.CH:CBr.COOH$	227.02	$C_9H_7O_2Br$
14 — — —, *β*	$C_6H_5.CBr:CH.COOH$	227.02	,,
15 — ethylene	$CH_2:CHBr$	106.95	C_2H_3Br
16 — hexahydrobenzene	$C_6H_5Br(H)_6$	163.04	$C_6H_{11}Br$
17 — naphthalene, *a*	$C_{10}H_7Br$	207.03	$C_{10}H_7Br$
18 — —, *β*	,, ,,	207.03	,,
19 — phenol, *o*	$Br.C_6H_4OH$	172.99	C_6H_5OBr
20 — —, *m*	,, ,,	172.99	,,
21 — —, *p*	,, ,,	172.99	,,
22 — phthalic acid, 5	$Br.C_6H_3:(COOH)_2$	242.00	$C_8H_5O_4Br$
23 — styrol, *a*	$C_6H_5.CH:CHBr$	183.02	C_8H_7Br
24 — —, *β*	$C_6H_5.CBr:CH_2$	183.02	,,
25 — toluene, *o*	$CH_3.C_6H_4.Br$	171.01	C_7H_7Br
26 — —, *m*	,, ,,	171.01	,,
27 — —, *p*	,, ,,	171.01	,,
28 Bromal	$CBr_3.COH$	280.78	C_2HOBr_3
29 Bromoform	$CHBr_3$	252.77	$CHBr_3$
30 Butane, *norm.*	$CH_3.CH_2.CH_2.CH_3$	58.10	C_4H_{10}
31 —, trimethylmethane	$CH(CH_3)_3$	58.10	,,
32 Butyl alcohol, *norm.*	$CH_3.CH_2.CH_2.CH_2OH$	74.10	$C_4H_{10}O$
33 — —, *iso.*	$(CH_3)_2:CH.CH_2OH$	74.10	,,
34 — —, ethyl methyl carbinol	$C_2H_5.CHOH.CH_3$	74.10	,,
35 — —, trimethyl carbinol	$(CH_3)_3COH$	74.10	,,
36 — amine, *norm*	$C_4H_9.NH_2$	73.12	$C_4H_{11}N$
37 — —, *sec.*	$CH_3.CH(NH_2)CH_2.CH_3$	73.12	,,
38 — benzene, *norm.*	$C_6H_5.C_4H_9$	134.16	$C_{10}H_{14}$

Density $H_2O=1$.	Solubility in— Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
				gas		1
1.6/15°					155	2
		s.		31—31.5	250—251	3
		s.		18—18.5	251	4
		s.		66.4	d.	5
		s.		204—205	subl.	6
		s.s.	s.h. C_6H_6	188	subl.	7
1.495/16°		s.		−31.1	156.15	8
	s.	v.s.	v.s.	150		9
	s.s.	v.s.	v.s.	155	>280	10
	v.s.s.	v.s.	v.s.	251		11
1.437	s. C_6H_6	s.s.	s. CS_2	76	274	12
		m.	m.	130—131		13
	h.s.	v.s.	v.s. CS_2	120		14
1.53/11°				liq.	16/750mm.	15
					162—163/714 d.	16
1.488/16°	m. C_6H_6	m. (abs.)	m.	liq.	277	17
1.605/0°	s. C_6H_6	v.s.	v.s.	59	281—282	18
				S.P. 5.6	194—195	19
				32—33	236—236.5	20
1.840/15°	s. $CHCl_3$	v.s.	v.s.	63.5	238	21
	v.s.	v.s.	v.s.	138—40		22
					150—160/75	23
				7	219—221	24
1.4222/20°				−25.9	180.3/754	25
1.4099/20°		s.		−39.8	183.7	26
1.3898/20°		s.	s.	26.5	183.6/758	27
3.34	d.			liq.	172.5—173	28
2.9045/15°	i.			7.8	146.5/757.5	29
	i.	18 vol. : 1		−135	0.6	30
0.6				−145	−10.2	31
0.8094/0°	1 : 12		s. HCl	liq.	116.9	32
0.8057/15°	1 : 10.5/18°			liq.	107.4	33
0.819/22°	s.			liq.	101/745mm.	34
0.7887/20°	m.			25	82.9	35
0.7401/20°	m.	s.	s.	liq.	75.5	36
0.7557/15°	m.			liq.	63	37
0.875/0°					186	38

	Name.	Formula.	Formula Weight.	Empirical Formula.
1	**Butyl benzene,** *iso.*	$C_6H_5.C_4H_9$	134.16	$C_{10}H_{14}$
2	**— —, *sec.***	,, ,,	134.16	,,
3	**— choral**	$C_4H_5Cl_3O$	175.44	$C_4H_5OCl_3$
4	**— — hydrate**	$C_4H_5Cl_3O.H_2O$	193.46	$C_4H_7O_2Cl_3$
5	**— chloride,** ***norm.***	$CH_3.CH_2.CH_2.CH_2Cl$	92.55	C_4H_9Cl
6	**— —, *iso.***	$(CH_3)_2:CH.CH_2Cl$	92.55	,,
7	**— —, *tert.***	$(CH_3)_3CCl$	92.55	,,
8	**— cyanide,** ***norm.***	$CH_3.CH_2.CH_2.CH_2CN$	83.11	C_5H_9N
9	**— —, *iso.***	$(CH_3)_2:CH.CH_2CN$	83.11	,,
10	**— —, *tert.***	$(CH_3)_3C.CN$	83.11	,,
11	**— ether**	$(C_4H_9)_2:O$	130.18	$C_8H_{18}O$
12	**— ethyl ether**	$C_4H_9.O.C_2H_5$	102.14	$C_6H_{14}O$
13	**— iodide,** ***norm***	$CH_3.CH_2.CH_2.CH_2I$	184.01	C_4H_9I
14	**— —, *iso.***	$(CH_3)_2:CH.CH_2I$	184.01	,,
15	**— —, *sec.***	$CH_3CH_2.CHI.CH_3$	184.01	,,
16	**— —, *tert.***	$(CH_3)_3CI$	184.01	,,
17	**— mercaptan**	C_4H_9SH	90.16	$C_4H_{10}S$
18	**— sulphide,** ***norm.***	$(CH_3.CH_2.CH_2.CH_2)_2S$	146.24	$C_8H_{18}S$
19	**— —, *sec.***	$(CH_3.CH_2.CH.CH_3)_2S$	146.24	,,
20	**— thiocyanate,** ***norm.***	$CH_3.CH_2.CH_2.CH_2.NCS$	115.17	C_5H_9NS
21	**— —, *iso.***	$(CH_3)_2:CH.CH_2.NCS$	115.17	,,
22	**— —, *sec.***	$CH_3.CH_2.CH(NCS)CH_3$	115.17	,,
23	**— —, *tert.***	$(CH_3)_3C.NCS$	115.17	,,
24	**Butylene,** ***norm.***	$CH_3CH_2.CH:CH_2$	56.08	C_4H_8
25	**—, *iso.***	$(CH_3)_2:C:CH_2$	56.08	,,
26	**—, *pseudo.***	$CH_3.CH:CH.CH_3$	56.08	,,
27	**— alcohol, β-butylene glycol**	$CH_3.CHOH.CH_2.CH_2OH$	90.10	$C_4H_{10}O_2$
28	**— —, α β-butylene-glycol**	$CH_3.CH_2.CHOH.CH_2OH$	90.10	,,
29	**— —, *pseudo.*-butylene-glycol**	$CH_3.CHOH.CHOH.CH_3$	90.10	,,
30	**— —, *iso*-butylene-glycol**	$(CH_3)_2:COH.CH_2OH$	90.10	,,
31	**— bromide, β**	$CH_3CHBr.CHBr.CH_3$	215.92	$C_4H_8Br_2$
32	**Butyramide,** ***norm.***	$CH_3.CH_2.CH_2.CONH_2$	87.10	C_4H_9ON
33	**—, *iso.***	$(CH_3)_2:CH.CONH_2$	87.10	,,
34	**Butyric acid,** ***norm.***	$CH_3.CH_2.CH_2.COOH$	88.08	$C_4H_8O_2$
35	**— —, *iso.***	$(CH_3)_2:CH.COOH$	88.08	,,
36	**Butyrate, amyl**	$C_3H_7.COO.C_5H_{11}$	158.19	$C_9H_{18}O_2$

Density $H_2O=1$.	Solubility in Water.	Solubility in Alcohol.	Solubility in Ether.	M.P. °C.	B.P. °C.	
0.8578/15°					167.5	1
0.8726/16°					170—172	2
1.395/20°	d.			liq.	164—165/750	3
1.693	h.s.	v.s.		78	d.	4
0.8874/20°				liq.	77.96	5
0.8336/15°				liq.	68.5	6
0.847/15°				liq.	51—52	7
0.816/0°				liq.	140.4/739	8
0.8227/0°	s.s			liq.	129.3	9
				15—16	105—106	10
0.7685/20°				liq.	140.5	11
0.7522/2°					91.7	12
1.6166/20°				liq.	131.4/745.4	13
1.6401/0°				liq.	120/745.4	14
1.6263/0°				liq.	118	15
1.571/0°	d.			liq.	98—99	16
0.858/0°				liq.	92	17
0.8523/0°	i.			liq.	182	18
0.8317/23°				liq.	165	19
				liq.	167	20
0.9638/14°				liq.	162	21
0.944/12°				liq.	159.5	22
0.9187/10°				10.5	140	23
					−5	24
	s. H_2SO_4				−6	25
0.635/—13°	i. H_2SO_4				+1/741.4mm.	26
1.0259	v.s.	s.	i.	liq.	203.5—204	27
1.019/0°	v.s.	m.		liq.	191—192	28
1.048/0°	m.	s.	s.	liq.	183—184	29
1.0129/0°	s.			liq.	178	30
1.821/0°					158	31
	v.s.	s.	s	116	216	32
	v.s.	s.	s.s.	127.5	216—220	33
0.9746/0°	m.	m.	m.	−8	162.3	34
0.9487/19.8°	1 : 5			−79	155.5	35
0.8832	s.s.	v.s.	v s.	liq.	178.6	36

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Butyrate, ethyl	$C_3H_7.COOC_2H_5$	116.13	$C_6H_{12}O_2$
2 — —, *iso.*	$(CH_3)_2:CH.COOC_2H_5$	116.13	,,
3 — methyl	$C_3H_7.COOCH_3$	102.11	$C_5H_{10}O_2$
4 — —, *iso.*	$(CH_3)_2:CH.COOCH_3$	102.11	,,
5 Butyric aldehyde, *norm*	$CH_3.CH_2.CH_2.CHO$	72.08	C_4H_8O
6 — —, *iso.*	$(CH_3)_2:CH.CHO$	72.08	,,
7 — anhydride, *norm.*	$(C_4H_7O)_2:O$	158.15	$C_8H_{14}O_3$
8 Butyrone	$(C_3H_7)_2CO$	114.15	$C_7H_{14}O$
9 Butyryl chloride, *norm*	$CH_3.CH_2.CH_2.COCl$	106.54	C_4H_7OCl
10 — —, *iso.*	$(CH_3)_2:CH.COCl$	106.54	,,
11 Cacodyl	$(CH_3)_2As_2(CH_3)_2$	210.04	$C_4H_{12}As_2$
12 — chloride	$(CH_3)_2AsCl$	140.48	C_2H_6ClAs
13 — oxide	$[(CH_3)_2As]_2O$	226.04	$C_4H_{12}OAs_2$
14 — sulphide	$[(CH_3)_2As]_2S$	242.10	$C_4H_{12}SAs_2$
15 — trichloride	$(CH_3)_2AsCl_3$	211.40	$C_2H_6Cl_3As$
16 Cacodylic acid	$(CH_3)_2AsO.OH$	138.03	$C_2H_7O_2As$
17 Cadaverine, see	Pentamethylene diamine		
18 Camphane	$C_{10}H_{18}$	138.19	$C_{10}H_{18}$
19 Camphene, l.	$C_{10}H_{16}$	136.18	$C_{10}H_{16}$
20 —, d.	,,	136.18	,,
21 Campholenic acid	$C_{10}H_{18}O_2$	170.19	$C_{10}H_{18}O_2$
22 Camphor, l.	$C_{10}H_{16}O$	152.18	$C_{10}H_{16}O$
23 —, d.	,,	152.18	,,
24 Camphoric acid	$C_5H_5(CH_3)_3(COOH)_2$	200.18	$C_{10}H_{16}O_4$
25 Camphoronic acid, d.	$C_9H_{14}O_6$	218.16	$C_9H_{14}O_6$
26 Camphor oxime, l.	$C_{10}H_{16}:NOH$	167.20	$C_{10}H_{17}ON$
27 Camphylamine	$C_9H_{15}.CH_2.NH_2$	153.21	$C_{10}H_{19}N$
28 Cane sugar, sucrose	$C_{12}H_{22}O_{11}$	342.24	$C_{12}H_{22}O_{11}$
29 Cantharidin	$C_{10}H_{12}O_4$	196.14	$C_{10}H_{12}O_4$
30 Capric acid	$C_9H_{19}COOH$	172.21	$C_{10}H_{20}O_2$
31 Caprate, ethyl	$C_9H_{19}.COOC_2H_5$	200.25	$C_{12}H_{24}O_2$
32 Caproic acid, *norm.*	$C_5H_{11}.COOH$	116.13	$C_6H_{12}O_2$
33 — —, *iso.*	$(CH_3)_2:CH.CH_2.CH_2.COOH$	116.13	,,
34 — —, diethyl acetic acid	$(C_2H_5)_2:CH.COOH$	116.13	,,
35 — —, dimethyl ethyl acetic acid	$(CH_3)_2(C_2H_5)C.COOH$	116.13	,,
36 Capronate, ethyl	$C_5H_{11}.COOC_2H_5$	144.17	$C_8H_{16}O_2$
37 Capronitrile	$C_5H_{11}CN$	97.13	$C_6H_{11}N$
38 Caprylic acid	$C_7H_{15}COOH$	144.17	$C_8H_{16}O_2$

Density $H_2O=1$.	Solubility in Water.	Solubility in Alcohol.	Solubility in Ether.	M.P. °C.	B.P. °C.	
0.8807/18°	0.5 : 100	s.	s.	-80	119.9	1
0.8710/20°	i.	s.		-116	110.1	2
0.9194/0°		s.		liq.	102—102.5	3
0.911/0°		s.	s.	liq.	92.4	4
0.8170/20°	1 : 27			liq.	73—74	5
0.7938/20°	1 : 9/20°			liq.	63/741mm.	6
0.978/15.5°				liq.	191—193	7
0.82/20°	i.			liq.	142	8
1.0277/20°				liq.	99—101/734.4	9
1.0174/20°				liq.	91.5—92.5/748.2	10
$>H_2O$	s.s.	s.	s.	-6	170	11
$>H_2O$	i.			liq.	100	12
1.462	s.s.			-25	120	13
	s.	s.			211	14
	d.					15
	v.s.	s.			200	16
						17
				158—159	160—161/763	18
0.879/60°				51—52	158.5—159.5	19
				50—51	158—159	20
	s. oils	1 : 0.8	v.s.	95	250	21
0.992/10°	s.s. acetic	s.	s.	172	204/757mm.	22
				176.4	209.1	23
1.193	h. 1 : 12	c. 1 : 0.89		187 (corr.)	d.	24
	s.	s.	s.s.	158—159 d.		25
		v.s.	v.s.	115	d. 250	26
0.93/37°					194—196	27
1.5881/20°	190 :100/10°	s.s.		160	d.	28
	i.	c. 0.03 :100	0.11 : 100	218		29
0.930/27°	h.s.s.	s.	s.	31	266—268	30
0.862				liq.	243—245	31
0.929/20°	s.s.			-1.5	205	32
0.9237/20°	s.s.				199.7	33
0.9196/15°	s.s.			liq	190.1	34
	i.			-14	187	35
0.8728/20°	i.	s.	s.	liq.	214	36
0.866/20°	s.s.	m.	m.	liq.	144—146	37
0.9270/0°	1 :400/100°	m.	m.	16.5	232—234	38

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Caprylate, ethyl	$C_7H_{15}.COOC_2H_5$	172.21	$C_{10}H_{20}O_2$
2 Carbamide chloride	$CO(NH_2)Cl$	74.09	CH_2ONCl
3 Carbamidine, see	Guanidine		
4 Carbanile	$C_6H_5.N:CO$	119.09	C_7H_5ON
5 Carbanilide	$CO:(NH.C_6H_5)_2$	212.18	$C_{13}H_{12}ON_2$
6 Carbazide	$CO:(NH.NH_2)_2$	90.09	CH_6ON_4
7 Carbazole	$(C_6H_4)_2:NH$	167.15	$C_{12}H_9N$
8 Carbodiphenylimide, α	$C(N.C_6H_5)_2$	194.11	$C_{13}H_{10}N_2$
9 —, β	,, ,,	194.11	,,
10 —, γ	,, ,,	194.11	,,
11 Carbostyril	$C_6H_4\left\langle\begin{array}{c}NH\\C_2H_2\end{array}\right\rangle CO$	145.11	C_9H_7ON
12 Carbyl sulphate	$CH_2.O.SO_2.O.SO_2.CH_2$	188.16	$C_2H_4O_6S_2$
13 Carminic acid	$C_{17}H_{18}O_{10}$	382.23	$C_{17}H_{18}O_{10}$
14 Carnine	$C_7H_8N_4O.H_2O$	182.16	$C_7H_8ON_4$
15 Carvacrol, 5 : 2 : 1	$C_6H_3(C_3H_7)(CH_3)OH$	150.16	$C_{10}H_{14}O$
16 Carvenone	$CH_3.CH\left\langle\begin{array}{c}CH_2.CH_2\\CO.CH\end{array}\right\rangle\!\!/\!\!/ C.CH:(CH_3)_2$	152.18	$C_{10}H_{16}O$
17 Carvomenthene	$C_{10}H_{18}$	138.19	$C_{10}H_{18}$
18 Carvomenthol	$C_{10}H_{19}OH$	156.21	$C_{10}H_{20}O$
19 Carvone, d.	$CH_3C\left\langle\begin{array}{c}CH.CH_2\\CO.CH_2\end{array}\right\rangle CH.C\left\langle\begin{array}{c}CH_3\\CH_2\end{array}\right.$	150.16	$C_{10}H_{14}O$
20 Caryophyllene	$C_{15}H_{24}$	204.27	$C_{15}H_{24}$
21 Catechin	$C_{15}H_{14}O_6$	290.19	$C_{15}H_{14}O_6$
22 Cedrene	$C_{15}H_{24}$	204.27	$C_{15}H_{24}$
23 Cellulose	$(C_6H_{10}O_5)x$	(162.11)	
24 Cerotic acid	$C_{26}H_{52}O_2$	396.55	$C_{26}H_{52}O_2$
25 Ceryl alcohol	$C_{26}H_{54}O_2$	382.56	$C_{26}H_{54}O_2$
26 Cetyl alcohol	$C_{16}H_{34}O$	242.35	$C_{16}H_{34}O$
27 Cetylene	$C_{16}H_{32}$	224.34	$C_{16}H_{32}$
28 Chelidonic acid	$C_5H_2O_2(COOH)_2$	184.67	$C_7H_4O_6$
29 Chinophenol, see	Hydroxy quinoline		

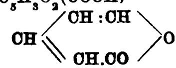
Density $H_2O=1$.	Solubility in Water.	Solubility in Alcohol.	Solubility in Ether.	M.P. °C.	B.P. °C.	
0.8730/16°	d.			liq.	205.8	1
	i.	i.		50	61—62	2
						3
1.092/15°	d.			liq.	166	4
	s.s.	s.	s.	239—240		5
				152—153		6
	i.	h.s.	s.	subl. 238	338	7
		h.d.	d.		163—165/11mm.	8
				158—160	235—236/65mm.	9
				96—98		10
	h.s.	v.s.	v.s.	199—200	subl.	11
	del. d.			80		12
	v.s.	s	s.s.			13
	h.s.	i	i.			14
0.9856/15°		s		0	236—237	15
0.927					235.5—236	16
0.8230/16.5°					174—175	17
0.908/20°					220	18
0.953/15°				liq.	227—228	19
	i.	s.s	s.	258—260	subl. 280	20
	h.s.	s.	s.	235—237	d.	21
0.9359/15°				liq.	237	22
	s. cupram					23
	i.	i.	i.	76—77	d.	24
	i.	s	s.	79	305/20mm.	25
0.8176/49°	i.	s.	s.	50—51	174—175/10	26
0.8039/20°				20	160/15mm.	27
	s.	s.	s.s.	d. 262		28
						29

Name.	Formula	Formula Weight.	Empirical Formula.
1 Chlor-acetanilide, *o*	$C_6H_4Cl.NH.COCH_3$	169.57	C_8H_8ONCl
2 — —, *m*	„ „	169.57	„
3 — —, *p*	„ „	169.57	„
4 — acetic acid	$CH_2Cl.COOH$	94.49	$C_2H_3O_2Cl$
5 — acetate, ethyl	$CH_2Cl.COOC_2H_5$	122.54	$C_4H_7O_2Cl$
6 — acetone	$CH_3.CO.CH_2Cl$	92.52	C_3H_5OCl
7 — acetylene	C_2HCl	60.48	C_2HCl
8 — acrylic acid, *α*	$CH_2:CCl.COOH$	106.50	$C_3H_3O_2Cl$
9 — — —, *β*	$CHCl:CH.COOH$	106.50	„
10 — aniline, *o*	$C_6H_4Cl.NH_2$	127.55	C_6H_6NCl
11 — —, *m*	„ „	127.55	„
12 — —, *p*	„ „	127.55	„
13 — benzene	C_6H_5Cl	112.53	C_6H_5Cl
14 — benzoic acid, *o*	$C_6H_4Cl.COOH$	156.54	$C_7H_5O_2Cl$
15 — — —, *m*	„ „	156.54	„
16 — — —, *p*	„ „	156.54	„
17 — benzyl chloride, 4 : 1	$C_6H_4Cl.CH_2Cl$	161.00	$C_7H_6Cl_2$
18 — — —, 2 : 1	„ „	161.00	„
19 — camphor	$C_{10}H_{16}Cl_2$	207.10	$C_{10}H_{16}Cl_2$
20 — carbonic ester	$COCl(OC_2H_5)$	108.52	$C_3H_5O_2Cl$
21 — crotonic acid, *α*	$CH_3.CH:CCl.COOH$	120.52	$C_4H_5O_2Cl$
22 — — —, *β*	$CH_3.CCl:CH.COOH$	120.52	„
23 — — —, *γ*	$CH_2Cl.CH:CH.COOH$	120.52	„
24 — dinitro benzene, 1 : 3 : 4*α*	$C_6H_3Cl(NO_2)_2$	202.53	$C_6H_3O_4N_2Cl$
25 1 : 3 : 4 *β*	„ „	202.53	„
26 1 : 3 : 4*γ*	„ „	202.53	„
27 1 : 2 : 6	„ „	202.53	„
28 1 : 2 : 4	„ „	202.53	„
29 1 : 3 : 5	„ „	202.53	„
30 — — phenol, 4 : 2 : 6 : 1	$C_6H_2Cl(NO_2)_2OH$	218.53	$C_6H_3O_5N_2Cl$
31 — diphenyl, *o*	$C_6H_4Cl.C_6H_5$	188.59	$C_{12}H_9Cl$
32 — —, *m*	„ „	188.59	„
33 — —, *p*	„ „	188.59	„
34 — hydrin, *α*	$CH_2Cl.CHOH.CH_2OH$	110.53	$C_3H_7O_2Cl$
35 — —, *β*	$CH_3.CCl(OH).CH_2OH$	110.53	„
36 — naphthalene, *α*	$C_{10}H_7Cl$	162.57	$C_{10}H_7Cl$
37 — —, *β*	„	162.57	„
38 — nitro benzene, *o*	$C_6H_4Cl(NO_2)$	157.53	$C_6H_4O_2NCl$
39 — — —, *m*	„ „	157.53	„

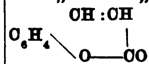
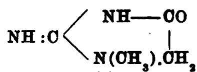
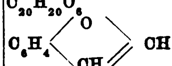
Density $H_2O=1$.	Solubility in— Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
		s.	s. C_6H_6	87—88		1
		s.	s. C_6H_6	72.5		2
		s.	s.	175		3
1.3947/73°	s.			62.5—63.2	186	4
1.1585/20°				liq.	143.5	5
0.5158/13°	s.s.	m.	m.	liq.	119	6
				gas		7
	m.	s.	s.	65	d. 176—181	8
			s. C_6H_6	84—85		9
1.2125/20°	12 :100/15°			S.P. −2.1	208.8	10
1.2149/20°				S.P. −10.4	230	11
1.1704/70°				70.5	232.3	12
1.1115		s.		−45	132	13
	0.21 :100/25°	s.		139.5		14
	1 :2840/0°	s.		156	subl.	15
	1 :5288/0°	s.	s.	234—240	subl.	16
		h.v.s.	v.s.	29	213—214	17
					213—214	18
		s.	v.s.	155—155.5		19
1.144/15°				liq.	93.1	20
	597 :100/19°	v.s.	v.s.	99.5	212	21
				94—94.5	206—211	22
				76.5—77.5	117—118/13mm.	23
		s.	s.	36.3 to γ		24
		s.		37.1 to γ		25
		s.	s.	38.8		26
1.678/16°		v.s.	s.	42	315	27
1.697/22°		s.		50	315	28
		s.	s.	53		29
				80.5		30
			s. ligroin	34	267—268	31
				89		32
			s. ligroin	75.5	282	33
	s.				213	34
					146/18mm.	35
1.2028/6.4°		s.	s. CS_2	liq.	250—252	36
1.2656/16°		s.		56	264—266/751	37
1.368/22°	i.	s.		32.5	243	38
1.534	i.	h.s.	v.s.	44.4	235.6	39

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Chlor nitro benzene, *p*	$C_6H_4Cl(NO_2)$	157.53	$C_6H_4O_2NCl$
2 — — naphthalene, 4 : 1	$C_{10}H_6Cl(NO_2)$	207.57	$C_{10}H_6O_2NCl$
3 — — —, 7 : 1	,, ,,	207.57	,,
4 — — phenol, OH : Cl : NO_2 = 1 : 6 : 2	$C_6H_3OH(NO_2)Cl$	173.53	$C_6H_4O_3NCl$
5 1 : 5 : 2	,, ,,	173.53	,
6 1 : 4 : 2	,, ,,	173.53	,,
7 1 : 2 : 4	,, ,,	173.53	,,
8 1 : 4 : 3	,, ,,	173.53	,,
9 1 : 5 : 3	,, ,,	173.53	,,
10 1 : 6 : 3	,, ,,	173.53	,,
11 — phenol, *o*	$C_6H_4Cl.OH$	128.53	C_6H_5OCl
12 — —, *m*	,, ,,	128.53	,,
13 — —, *p*	,, ,,	128.53	,,
14 — phthalic acid, 1 : 2 : 4	$C_6H_3Cl(COOH)_2$	200.54	$C_8H_5O_4Cl$
15 — propionic acid, *a*	$CH_3.CHCl.COOH$	108.52	$C_3H_5O_2Cl$
16 — — —, *β*	$CH_2Cl.CH_2.COOH$	108.52	,,
17 — pyridine, *o*	$C_5H_4N.Cl$	113.53	C_5H_4NCl
18 — —, *m*	,,	113.53	,,
19 — —, *p*	,,	113.53	,,
20 — quinoline, *o*	$C_9H_6N.Cl$	163.56	C_9H_6NCl
21 — —, *p*	,,	163.56	,,
22 — toluene, *o*	$C_6H_4.(Cl)CH_3$	126.55	C_7H_7Cl
23 — —, *m*	,, ,,	126.55	,,
24 — —, *p*	,, ,,	126.55	,,
25 — trinitro-benzene, 5 : 1 : 2 : 4	$C_6H_2Cl(NO_2)_3$	247.54	$C_6H_2O_6N_3Cl$
26 2 : 1 : 3 : 5	,, ,,	247.54	,,
27 Choral	$CCl_3.COH$	147.40	C_2HOCl_3
28 — alcoholate	$CCl_3.CH(OC_2H_5)OH$	193.46	$C_4H_7O_2Cl_3$
29 — hydrate	$CCl_3.CH(OH)_2$	165.41	$C_2H_3O_2Cl_3$.
30 Chloranil	$C_6Cl_4O_2$	245.87	$C_6O_2Cl_4$
31 Chloroform	$CHCl_3$	119.39	$CHCl_3$
32 Chloropicrin	$C(NO_2)Cl_3$	164.40	CO_2NCl_3
33 Cholesterol	$C_{26}H_{43}OH$	372.48	$C_{26}H_{44}O$
34 — benzoate	$C_{26}H_{43}O.C_7H_5O$	476.55	$C_{33}H_{48}O_2$
35 Cholic acid	$C_{24}H_{40}O_5.H_2O$	426.46	$C_{24}H_{40}O_5$
36 Choline	$C_2H_4OH.N(CH_3)_3OH$	121.16	$C_5H_{15}O_2N$
37 Chrysamminic acid	$C_{14}H_2(NO_2)_4(OH)_2O_2$	420.14	$C_{14}H_4O_{12}N$
38 Chrysaniline	$C_{19}H_{15}N_3$	285.25	$C_{19}H_{15}N_3$

Density $H_2O=1$.	Solubility in— Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
1.380/22°	i.	s.		83	242	
	i.	s.	s.	85		2
	i.	s.		116		3
	s.s.		s. $CHCl_3$	70		4
				38.9		5
	v.s.s.	s.	s., s. $CHCl_3$	86—87		6
	v.s. $CHCl_3$	v.s	v.s.	110—111		7
				126—127		8
				147		9
				118—119		10
		s.		7	175	11
		s.	s.	32—33	214	12
1.306/20.5°	s.s.	v.s	v.s.	37	217	13
	s.	s.		148		14
1.28/0°	m.	s.		liq.	186	15
	v.s.	v.s		41.5	203—205	16
	s.			liq.	166	17
				liq.	148	18
	s.			liq.	147—148	19
1.2754/16.6°	i.	s.	v.s.	37—38	275	20
1.3766/16.6°		s.	s.	34	260—261	21
1.0807/20°				−34	159.4	22
1.07218/20°				−47.8	162.2	23
				7.4	162.3	24
		s.s.		116		25
1.790/22°	i.	h.s.	s.s.	83		26
1.512/20°	v.s.	s.		−57.5	97.7	27
1.143/40°	s. d.	s.		46	115	28
1.5745/66°	s.	s.	s. CS_2	47.4	96—98 d.	29
	i.	h.s.s.	s.s.	290	subl.	30
1.5039/11.8°	v.s.s.	s.	s.	−63.2	61.2	31
1.0697/20°	i.	3.7 : 1		−64	111.9	32
1.067	i.	h. 1 : 9	s., s. CS_2	145—146		33
		i.	s.	146.6		34
	v.s.s.	s.	s.s.	197		35
	s.	v.s.	v.s.			36
	i.	s.	s.			37
	s.s.	s.s.		267—270		38

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Chrysarobin	$C_{15}H_{12}O_2$	224.17	$C_{15}H_{12}O_2$
2 Chrysazine, 1 : 8	$OH.C_6H_3:(CO)_2:C_6H_3.OH$	240.06	$C_{14}H_8O_4$
3 Chrysazol, see	Dihydroxy anthracene		
4 Chrysene	$C_{18}H_{12}$	228.19	$C_{18}H_{12}$
5 Chrysine	$C_{15}H_{10}O_4$	254.16	$C_{15}H_{10}O_4$
6 Chryso-quinone, 1 : 2	$C_{18}H_{10}O_2$	258.17	$C_{18}H_{10}O_2$
7 ——, 2 : 8	,,	258.17	,,
8 Chrysophanic acid	$C_{14}H_5O_2(OH)_2CH_3$	254.16	$C_{15}H_{10}O_4$
9 Cinchomeronic acid	$C_5H_3N(COOH)_2$, 3 : 4	167.09	$C_7H_5O_4N$
10 Cineol	$C_{10}H_{18}O$	154.19	$C_{10}H_{18}O$
11 Cineolic acid	$C_{10}H_{16}O_5$	216.18	$C_{10}H_{16}O_5$
12 Cinnamic acid	$C_6H_5.CH:CH.COOH$	148.11	$C_9H_8O_2$
13 Cinnamate, benzyl	$C_6H_5.CH:CH.COO.C_7H_7$	238.19	$C_{16}H_{14}O_2$
14 —, ethyl	$C_6H_5.CH:CH.COO.C_2H_5$	176.15	$C_{11}H_{12}O_2$
15 Cinnamic acid chloride	$C_6H_5.CH:CH.COCl$	166.56	C_9H_7OCl
16 — aldehyde	$C_6H_5.CH:CH.CHO$	132.11	C_9H_8O
17 — alcohol	$C_6H_5.CH:CH.CH_2OH$	134.13	$C_9H_{10}O$
18 — anhydride	$(C_9H_7O)_2:O$	278.20	$C_{18}H_{14}O_3$
19 — carboxylic acid, *o*	$COOH.C_6H_4.CH:CH.COOH$	192.11	$C_{10}H_8O_4$
20 Citraconic acid	$C_3H_4(COOH)_2$	130.07	$C_5H_6O_4$
21 Citral	$C_{10}H_{16}O$	152.18	$C_{10}H_{16}O$
22 Citramalic acid	$COOH(CH_3):C(OH).CH_2.COOH$	148.09	$C_5H_8O_5$
23 Citrene	$C_{10}H_{16}$	136.18	$C_{10}H_{16}$
24 Citric acid	$C_3H_4(OH)(COOH)_3.H_2O$	210.11	$C_6H_8O_7$
25 Citronellal	$C_{10}H_{18}O$	154.19	$C_{10}H_{18}O$
26 Cœrulein	$C_{20}H_{12}O_6$	348.20	$C_{20}H_{12}O_6$
27 Cœrulignone	$C_{16}H_{16}O_6$	340.21	$C_{16}H_{16}O_6$
28 Collidine, α	$C_5H_2N(CH_3)_3$	121.14	$C_8H_{11}N$
29 —, β	,, ,,	121.14	,,
30 —, γ	,, ,,	121.14	,,
31 Coniferin	$C_{16}H_{22}O_8.2H_2O$	378.29	$C_{16}H_{22}O_8$
32 Coniferyl alcohol	$C_{10}H_{12}O_3$	180.15	$C_{10}H_{12}O_3$
33 Conylene	C_8H_{14}	110.15	C_8H_{14}
34 Coumalic acid	$C_5H_3O_2(COOH)$	140.06	$C_6H_4O_4$
35 Coumalin		96.06	$C_5H_4O_2$

Density $H_2O=1$.	Solubility in Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
	i.	s.	s. $CHCl_3$	170—178		1
	s. acetic	s.	s.	191		2
						3
	s.s.	s.s.	s. acetic	250	448	4
	s. alk.	c. 1 : 180	s.s.	275	subl.	5
	s. H_2SO_4	h.s.	s.s.	237	subl.	6
				288—290 d.		7
	i.	h. 1 : 24	s.	196	subl.	8
	s.s.	s.s.	v.s.s.	258—259		9
0.9267/20°	d.			−1	176	10
	c. 1 : 70		s.	196—197 d.		11
1.249	0.0546 : 100/25°	s.	v.s.	133	300	12
				39	225—235	13
1.0498/20°		s.		12	271	14
				35—36	170—171/58	15
1.0497/24°		s.	s.	−7.5	126—127/15	16
1.044/20°	s.s.	v.s.	v.s.	33	250	17
	i.	s.s.		136		18
	s.s.	s.	s.s.	173—175		19
1.617	1 : 0.42/15°			80	91 d.	20
0.8972/15°	i.				224—225 d.	21
	s.	s.	s.	119	d. 130	22
0.85/15°		s.		liq.	168—168.5	23
1.542	c. 133 : 100	87 : 100	9.1 : 100	153, an. 100	d.	24
0.8538/17.5°					205—208	25
	v.s.s.	s.s.	s. alk.			26
	h.s.	i.	s. H_2SO_4	d.		27
0.929/0°	s.s.	s.	s.	liq.	180	28
0.966/0°	i.	s.		liq.	195—196	29
0.917/15°	i.	s.	s.	liq.	171—172	30
	h.s.	s.	i.	185	d.	31
	h.s.s.	s.	s.	73—74		32
0.76/15°		s.			125	33
	c.s.s.	s.	s.s.	205—210 d.	subl.	34
1.2	m.	s.	s.	5	206—209 d.	35

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Coumaric acid, *o*	$C_6H_4(OH)C_2H_2.COOH$	164.11	$C_9H_8O_3$
2 — —, *p*	,, ,,	164.11	,,
3 Coumarin		146.10	$C_9H_6O_2$
4 Creatine	$NH_2.C(:NH).N(CH_3).CH_2COOH(.H_2O)$	131.12	$C_4H_9O_2N_3$
5 — *iso*., methyl glycocyamide	$C_4H_9N_3O_2$	131.12	,,
6 Creatinine, methyl glycocyamidine		113.11	$C_4H_7ON_3$
7 Cresol, *o*	$CH_3.C_6H_4.OH$	108.10	C_7H_8O
8 —, *m*	,, ,,	108.10	,,
9 —, *p*	,, ,,	108.10	,,
10 Cresorcinol, see	Dihydroxy toluene		
11 Cresotic acid, 1 : 4 : 3	$C_6H_3(CH_3)(OH)COOH$	152.10	$C_8H_8O_3$
12 — —, 1 : 3 : 2	,, ,,	152.10	,,
13 — —, 1 : 3 : 4	,, ,,	152.10	,,
14 Cresotinic acid, see	Hydroxy toluic acid		
15 Croconic acid	$C_5O_3(OH)_2(3H_2O)$	142.04	$C_5H_2O_5$
16 Crotonaldehyde, α	$CH_3.CH:CH.CHO$	70.07	C_4H_6O
17 Crotonic acid, α	$CH_3.CH:CH.COOH$	86.07	$C_4H_6O_2$
18 — —, β	$CH_2:CH.CH_2.COOH$	86.07	,,
19 Crotonyl alcohol	$CH_3.CH:CH.CH_2OH$	72.08	C_4H_8O
20 Crotonylene	$CH_3.C \vdots C.CH_3$	54.07	C_4H_6
21 Cubebine	$C_{20}H_{20}O_6$	356.26	$C_{20}H_{20}O_6$
22 Cumarone		118.09	C_8H_6O
23 Cumene	$C_6H_5.CH:(CH_3)_2$	120.14	C_9H_{12}
24 Cumidic acid	$(CH_3)_2:C_6H_2:(COOH)_2$	194.18	$C_{10}H_{10}O_4$
25 Cumidine, 1 : 2 : 4 : 5	$(CH_3)_3C_6H_2.NH_2$	135.16	$C_9H_{13}N$
26 —, amino *iso*-propyl benzene	$C_3H_7.C_6H_4.NH_2$	135.16	,,
27 Cumin alcohol, *p*	$C_3H_7.C_6H_4.CH_2OH$	150.16	$C_{10}H_{14}O$
28 — aldehyde, cuminol	$C_3H_7.C_6H_4.CHO$	148.15	$C_{10}H_{12}O$
29 Cuminic acid	$C_3H_7.C_6H_4.COOH$	164.15	$C_{10}H_{12}O_2$
30 Cumylic acid, 1 :2 :4 :5	$(CH_3)_3C_6H_2.COOH$	164.15	$C_{10}H_{12}O_2$

Density $H_2O=1$.	Solubility in Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
	h.s.	s.	v.s.s.	214	d.	1
	c.v.s.s.	v.s.	v.s.	215		2
0.9348/7.3°	s.s.	v.s.	s.	67	290—290.5 subl.	3
	h.s.	i.		220 d.		4
	1 : 12	h.s.s.		d. 220		5
	s.	h.s.				6
1.0427/23.2°	s.s.	s.	s.	30	190.8	7
1.0350/13.6°	s.s.	s.	s.	3—4	200.5	8
1.0340/17.7°	s.s.	s.	s.	36	201.1	9
						10
	s.	v.s.	v.s.	150		11
	s.	s.	s., s. $CHCl_3$	163—164		12
	s.	s.	s.	177	236—237	13
						14
	v.s.	s.		an. 100		15
0.8557/17.3°	s.			liq.	103—104	16
1.018	1 : 12/15°		s. ligroin.	71—72	180—181	17
1.018	m.				172	18
					117—120	19
	i.	s. cupram.		liq.	27.2—27.6	20
	v.s.s.	1.31 : 100/12°	3.75/100	131—132		21
1.0767/15°	i.			liq.	171—172	22
0.866/15°	i.	s.	s.	−75.1	152.5—153.5	23
	s.s.	h.s.	v.s.	>320		24
0.9526	s.	s.		64	225	25
	s.	s.	s. C_6H_6		213.5—214.5/ 732mm.	26
0.9775/15°	s.s.	m.	m.	liq.	246.6	27
0.9832	h.s.	s.	s.	liq.	237	28
1.1625/4°	0.015 : 100/25°	s.	s.	117	subl.	29
	h.s.s.	v.s.	s., s. C_6H_6	149—150		30

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Curcumin	$C_{14}H_{14}O_4$	246.18	$C_{14}H_{14}O_4$
2 Cyamelide	$(CNOH)x$	(43.03)	
3 Cyan-acetic acid	$CH_2CN.COOH$	85.05	$C_3H_3O_2N$
4 — amide	$NC.NH_2$	42.04	CH_2N_2
5 — anilide	$C_6H_5.NH.CN$	118.10	$C_7H_6N_2$
6 — aniline	$(C_6H_7N)_2(CN)_2$	238.20	$C_{14}H_{14}N_4$
7 — carbonic ester	$CN.COOC_2H_5$	99.07	$C_4H_5O_2N$
8 — etholine	$CN.OC_2H_5$	71.07	C_3H_5ON
9 — naphthalene, α	$C_{10}H_7CN$	153.12	$C_{11}H_7N$
10 — —, β	,,	153.12	,,
11 — propionic acid, α	$CH_3.CH(CN)COOH$	99.07	$C_4H_5O_2N$
12 — sulphide	$(CN)_2:S$	84.09	C_2N_2S
13 — uramide	$C_3N_3(NH_2)_2$	110.10	$C_3H_4N_5$
14 Cyanethine	$CH_3.C-CH=C.NH_2$ $\quad\;\Vert\qquad\;\vert$ $\quad N.C(CH_3)=N$	123.13	$C_6H_9N_3$
15 Cyanogen	C_2N_2	52.03	C_2N_2
16 — chloride, liq.	$CN.Cl$	61.48	$CNCl$
17 — —, solid	$C_3N_3Cl_3$	184.43	$C_3N_3Cl_3$
18 Cyanuric acid, *iso.*	$C_3N_3(OH)_3.2H_2O$	165.10	$C_3H_3O_3N_3$
19 Cymene, 1 : 4	$CH_3.C_6H_4.C_3H_7$	134.16	$C_{10}H_{14}$
20 —, 1 : 2	,, ,,	134.16	,,
21 —, 1 : 3	,, ,,	134.16	,,
22 Dambose	$C_6H_{12}O_6.2H_2O$	216.16	$C_6H_{12}O_6$
23 Daphnetin	$C_9H_6O_4$	178.09	$C_9H_6O_4$
24 Deca hydro-naphthalene	$C_{10}H_8(H_{10})$	138.19	$C_{10}H_{18}$
25 — — quinoline	$C_9H_7N(H_{10})$	139.19	$C_9H_{17}N$
26 Decatyl alcohol	$C_{10}H_{21}OH$	158.23	$C_{10}H_{22}O$
27 Dehydracetic acid	$CH_3.CO.CH.CO.CH$ $\qquad\quad\vert\qquad\;\Vert$ $\qquad CO.\,O.\,C.CH_3$	168.10	$C_8H_8O_4$
28 Desoxalic acid	$C_2H(OH)_2(COOH)_3$	194.07	$C_5H_6O_8$
29 Desoxybenzoin	$C_6H_5.CO.CH_2.C_6H_5$	196.17	$C_{14}H_{12}O$
30 Dextrin	$C_6H_{10}O_5$	162.11	$C_6H_{10}O_5$
31 Dextrose	$C_6H_{12}O_6$	180.13	$C_6H_{12}O_6$
32 Diacetamide	$(CH_3CO)_2:NH$	101.09	$C_4H_7O_2N$
33 Diacetanilide	$(CH_3CO)_2:N.C_6H_5$	177.15	$C_{10}H_{11}O_2N$
34 Diacethydroquinone	$C_6H_4O_2(CH_3CO)_2$	194.13	$C_{10}H_{10}O_4$
35 Diacetin	$C_3H_5OH(O.COCH_3)_2$	176.13	$C_7H_{12}O_5$

Density $H_2O=1$.	Solubility in Water.	Solubility in Alcohol.	Solubility in Ether.	M.P. °C.	B.P. °C.	
	s. alk.	s.	s.	178		1
	i.				d.	2
	i.	v.s.	v.s.	69	d.	3
	v.s.	v.s.	v.s.	41—42	143—144/18	4
	s.s.	s.	s.	47		5
	i.	s.s.	s.s.	214	d.	6
$>H_2O$	i.	s.	s.	liq.	115—116	7
1.127/15°	i.	m.	m.	liq.	d.	8
		s.		33.5	296.5	9
		s.		66.5	304—305	10
	v.s.	v.s.		d. 140		11
	s.	s.	s.	60	d.	12
	s.s.	i.	i.	subl. d.		13
	s.			180—181	subl.	14
	4.5 : 1 vol.	22 : 1 vol.		−35	−21	15
$>H_2O$	s.s.	s.	s.		15.5	16
1.32			s.	145	190	17
	1 : 40	s.				18
0.852/15°	i.	s.	s.	−73.5	175	19
0.858	i.	s.			157	20
0.865	i.	s.			175—176	21
1.524	v.s.	i. (abs.)		225	319	22
	h.v.s.	h.s.	v.s.s.	d. 253—256		23
0.837/19°					187—188	24
	h.s.	v.s.	v.s.	48.2—48.5	204/714mm.	25
0.8389/7°		s.		7	231	26
	s.	h.s.	s.	108.5—109	269.9	27
	v.s.	v.s.		liq.	d.	28
	s.s.	s.	s.	60—61	320—322	29
1.03845	s.	i. (abs.)				30
1.54—1.57	81 : 100	s.	s. CH_3OH	an. 146	d.	31
	v.s.	s.	s.	77.5—78	222.5—223.5	32
		s. C_6H_6	s. ligroin.	38	145—146/13	33
	h.s.s.	s.s.	v.s.	123—124		34
	m.		m.	40	259	35

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Diacetyl	$CH_3.CO.CO.CH_3$	86.09	$C_4H_6O_2$
2 — acetic ester	$(CH_3CO).CH.COOC_2H_5$	129.10	$C_6H_9O_3$
3 — glucose	$C_5H_6(OCH_3.CO)_2(OH)_3.COOH$	264.18	$C_{10}H_{16}O_8$
4 Diacetylene	$CH : C.C : CH$	50.04	C_4H_2
5 Diallyl	$(C_3H_5)_2$	82.11	C_6H_{10}
6 Dialuric acid	$C_4H_4N_2O_4$	144.07	$C_4H_4O_4N_2$
7 Diamino-anthraquinone, 1 : 4	$C_{14}H_6O_2(NH_2)_2$	238.17	$C_{14}H_{10}O_2N_2$
8 — —, 1 : 5	" "	238.17	"
9 — —, 1 : 8	" "	238.17	"
10 — benzoic acid, COOH : NH_2 : NH_2 = 1 : 2 : 3	$C_6H_3(NH_2)_2COOH$	152.12	$C_7H_8O_2N_2$
11 1 : 3 : 4	" "	152.12	"
12 1 : 3 : 5	" " $.H_2O$	170.14	"
13 — benzophenone, 2 : 2′	$(C_6H_4NH)_2CO$	210.17	$C_{13}H_{10}ON_2$
14 — —, 4 : 4′	" "	210.17	"
15 — diphenylamine, 4 : 4′	$(C_6H_4.NH_2)_2NH$	199.19	$C_{12}H_{13}N_3$
16 — diphenylmethane	$(C_6H_4.NH_2)_2CH_2$, 4 : 4′	198.20	$C_{13}H_{14}N_2$
17 — stilbene	$(C_6H_4.NH_2)_2C_2H_2$	210.20	$C_{14}H_{14}N_2$
18 — triphenylmethane	$C_6H_5.CH(C_6H_4.NH_2)_2$, 4 : 4′	274.26	$C_{19}H_{18}N_2$
19 Dianisidine	$C_{12}H_6(OCH_3)_2(NH_2)_2$	244.22	$C_{14}H_{16}O_2N_2$
20 Diazo-acetic ester	$(COOC_2H_5)CHN_2$	114.09	$C_4H_4O_2N_2$
21 — amino-benzene	$C_6H_5.N_2.NH.C_6H_5$	197.18	$C_{12}H_{11}N_3$
22 — — naphthalene	$C_{10}H_7.N_2.NH.C_{10}H_7$	297.25	$C_{20}H_{15}N_3$
23 benzene chloride	$C_6H_5.N_2.Cl$	140.55	$C_6H_5N_2Cl$
24 — — cyanide	$C_6H_5.N_2.CN.HCN$	158.13	$C_8H_6N_4$
25 — — imide	$C_6H_5.N<\begin{matrix}N\\ \|\\ N\end{matrix}$	119.10	$C_6H_5N_3$
26 — — nitrate	$C_6H_5.N_2.NO_3$	167.10	$C_6H_5O_3N_3$
27 — — sulphonic acid, *m*	$C_6H_4<\begin{matrix}N_2\\ \vert\\ SO_3\end{matrix}$	184.14	$C_6H_4O_3N_2S$
28 — — — —, *p*	" "	184.14	"
29 — methane	CH_2N_2	42.04	CH_2N_2
30 Dibenzyl	$C_6H_5.CH_2.CH_2.C_6H_5$	182.18	$C_{14}H_{14}$
31 — amine	$(C_6H_5.CH_2)_2 : NH$	197.20	$C_{14}H_{15}N$
32 — ketone	$(C_6H_5.CH_2)_2 : CO$	210.19	$C_{15}H_{14}O$

Density $H_2O=1$.	Solubility in Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
0.9734/22°	1 : 4/15°				87.5—88	1
1.064/15°	s.s.			liq.	d. 200—205	2
	s.	s.	s.	<100		3
				gas		4
0.6895/20°	i.			liq.	59—59.6/744	5
	s.s.					6
	v.s.s.	s.	s., s. C_6H_6	268	subl.	7
	s.s.	s.	s.	319		8
	i.	s.		262		9
	s.s.			190—191 d.		10
	h.s.			d. 210—211		11
	h.s.	v.s.	v.s.	an. 236	d	12
	h.s.	s.	s.	172		13
	h.s.	s.	s.	239	d. 250	14
	s.s.		s.	158	d.	15
	v.s.	v.s.	s. C_6H_6	88—89		16
	s.s.	s.		227—228	subl. d.	17
	v.s.s.	s.	s.	139		18
	h.s.s.	h.s.	s.s., s. C_6H_6	135		19
1.083/24°	s.s.	m.	m.		140—141 d.	20
	i.	h.s.	v.s.	96	expl.	21
			s.	expl. 174		22
	s.	s.s.				23
	s.s.			70		24
	i.					
1.124/0°		s.s.	s.s.	oil	73.5/22—24	25
1.37	v.s.	s.s.	v.s.s.	expl.		26
	s., d. 60°			d.		27
	c.i., 60° s., h.d.					28
			s.		gas.	29
0.9416/80.6°	s. CS_2	s.s.	s.	52	284	30
1.033/14°	s. CS_2	s.	s.	liq.	300	31
			s.s.	33	331	32

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Dibenzylidine acetone	$(C_6H_5.CH:CH)_2CO$	234.20	$C_{17}H_{14}O$
2 Dibromo anthracene	$C_6H_4:C_2Br_2:C_6H_4$, 9 : 10	335.97	$C_{14}H_8Br_2$
3 — anthraquinone, 1 : 2	$C_6H_4:(CO)_2:C_6H_2Br_2$	366.90	$C_{14}H_6O_2Br_2$
4 — —, 2 : 6	$C_6H_3Br:(CO)_2:C_6H_3Br$	366.90	,,
5 — —, 2 : 7	,, ,,	366.90	,,
6 — benzene, *o*	$C_6H_4Br_2$	235.90	$C_6H_4Br_2$
7 — —, *m*	,,	235.90	,,
8 — —, *p*	,,	235.90	,,
9 — succinic acid	$C_2H_2Br_2(COOH)_2$	275.89	$C_4H_4O_4Br_2$
10 Dichlor acetal	$CHCl_2.CH:(OC_2H_5)_2$	187.05	$C_6H_{12}O_2Cl_2$
11 — acetaldehyde	$CHCl_2.CHO$	112.95	$C_2H_2OCl_2$
12 — acetamide	$CHCl_2.CONH_2$	127.96	$C_2H_3ONCl_2$
13 — acetic acid	$CHCl_2.COOH$	128.95	$C_2H_2O_2Cl_2$
14 — acetate, ethyl	$CHCl_2.COOC_2H_5$	156.99	$C_4H_6O_2Cl_2$
15 — acetone	$CHCl_2.CO.CH_3$	126.97	$C_3H_4OCl_2$
16 — aniline, 1 : 2 : 4	$C_6H_3Cl_2.NH_2$	162.00	$C_6H_5NCl_2$
17 — —, 1 : 2 : 5	,,	162.00	,,
18 — —, 1 : 3 : 5	,,	162.00	,,
19 — —, 1 : 3 : 4	,,	162.00	,,
20 — anthracene	$C_{14}H_8Cl_2$	247.05	$C_{14}H_8Cl_2$
21 — benzene, *o*	$C_6H_4Cl_2$	146.98	$C_6H_4Cl_2$
22 — —, *m*	,,	146.98	,,
23 — —, *p*	,,	146.98	,,
24 — benzoic acid, 1 : 3 : 4	$C_6H_3Cl_2.COOH$	190.99	$C_7H_4O_2Cl_2$
25 — — —, 1 : 2 : 5	,, ,,	190.99	,,
26 — diphenyl, *p*	$C_6H_4Cl.C_6H_4Cl$	234.04	$C_{12}H_8Cl_2$
27 — ether	$CH_2Cl.CHCl.O.C_2H_5$	143.00	$C_4H_8OCl_2$
28 — ethylene, asym.	$CH_2:CCl_2$	96.95	$C_2H_2Cl_2$
29 — —, sym.	$CHCl:CHCl$	96.95	,,
30 — hydrin, $\alpha\gamma$	$CH_2Cl.CHOH.CH_2Cl$	128.98	$C_3H_6OCl_2$
31 — —, $\beta\gamma$	$CH_2Cl.CHCl.CH_2OH$	128.98	,,
32 — —, $\alpha\alpha$	$CH_3.CHOH.CHCl_2$	128.98	,,
33 — naphthalene, 1 : 2	$C_{10}H_6Cl_2$	197.02	$C_{10}H_6Cl_2$
34 — —, 1 : 3	,,	197.02	,,
35 — —, 1 : 4	,,	197.02	,,
36 — —, 1 : 5	,,	197.02	,,
37 — —, 1 : 6	,,	197.02	,,
38 — —, 1 : 7	,,	197.02	,,
39 — —, 1 : 8	,,	197.02	,,

Density $H_2O=1$.	Solubility in Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
	s. acetone	s.s.	s.s.	112—113		1
	s.h. C_6H_6	v.s.s.	s.s.	220—221	subl.	2
		s.s.	s. C_6H_6	265		3
		v.s.s.	s. C_6H_6	289—290		4
				323		5
1.977/18°		s.	s. C_6H_6	5.6	223.8/751	6
1.955/19°		s.		1—2	219.4/758.4	7
1.8408/89.3°		s.	s.	87.2	219	8
	h.s.	s.	s.	255—256		9
1.1383/14°	s.s.			liq.	183—184	10
	i.			liq.	88—90	11
				97—98	233—234/745	12
1.5216/15°				−4	189—191	13
1.282/20°				liq.	156—157	14
1.236/21°	s.s.			liq.	120	15
		s.		63	245	16
		s.		50	251	17
		s.		50.5	259—260	18
		s.		71	272	19
	s. C_6H_6	s.s.	s.s.	209		20
1.3278/0°		s.	s.s.	−14	179	21
1.3047/0°		s.		−18	172	22
1.458/20°	s. C_6H_6	h.m.	v.s.	52.8	179	23
	s.s.	s.		201—202		24
	1 : 1193/11°	s.		156	301	25
				148	315	26
1.174/23°					140—145	27
1.250/15°					37	28
					55	29
1.396/16°	1 : 6/72°			liq.	174—175	30
1.3799/0°				liq.	183	31
					146—148	32
		s.		34—35	280—282	33
				61	289	34
		s.		67—68	286—287/740	35
		s.		107	subl.	36
				48		37
		v.s.		62	286	38
				83		39

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Dichlor naphthalene, 2 : 3	$C_{10}H_6Cl_2$	197.02	$C_{10}H_6Cl_2$
2 — —, 2 : 6	„	197.02	„
3 — —, 2 : 7	„	197.02	„
4 — *m* phenylene diamine, 2 : 5 : 1 : 3	$C_6H_2Cl_2(NH_2)_2$	177.02	$C_6H_6N_2Cl_2$
5 — quinoline, 2 : 3	$C_9H_5NCl_2$	198.02	$C_9H_5NCl_2$
6 — —, 2 : 4	„	198.02	„
7 — —, 2 : 6	„	198.02	„
8 — —, 2 : 7	„	198.02	„
9 — —, 5 : 6	„	198.02	„
10 — —, 5 : 7	„	198.02	„
11 — —, 5 : 8	„	198.02	„
12 — —, 6 : 8	„	198.02	„
13 — quinone, 2 : 6	$C_6H_2O_2Cl_2$	176.97	$C_6H_2O_2Cl_2$
14 — —, 2 : 3	„	176.97	„
15 — —, 2 : 5	„	176.97	„
16 — stilbene	$C_{14}H_{10}Cl_2$	249.07	$C_{14}H_{10}Cl_2$
17 Dicyanogen diamide	$HN:C(NH_2).NH.CN$	84.08	$C_2H_4N_4$
18 — diamidine	$HN:C(NH_2).NH.CO.NH_2$	102.10	$C_2H_6ON_4$
19 Diethyl amine	$(C_2H_5)_2:NH$	73.12	$C_4H_{11}N$
20 — aniline	$C_6H_5.N:(C_2H_5)_2$	149.18	$C_{10}H_{15}N$
21 — benzene, *p*	$C_6H_4:(C_2H_5)_2$	134.16	$C_{10}H_{14}$
22 — cyanamide	$CN.N:(C_2H_5)_2$	98.12	$C_5H_{10}N_2$
23 — glycollic acid	$(C_2H_5)_2:C(OH)COOH$	132.13	$C_6H_{12}O_3$
24 — ketone	$(C_2H_5)_2:CO$	86.11	$C_5H_{10}O$
25 — phosphine	$(C_2H_5)_2:PH$	90.15	$C_4H_{11}P$
26 — phosphoric acid	$PO(OC_2H_5)_2OH$	154.15	$C_4H_{11}O_4P$
27 — urea, α	$CO:(NH.C_2H_5)_2$	116.14	$C_5H_{12}ON_2$
28 — —, β	$NH_2.CO.N:(C_2H_5)_2$	116.14	„
29 Diethylene diamine, piperazine	$NH:(C_2H_4)_2:NH$	86.12	$C_4H_{10}N_2$
30 — glycol	$CH_2OH.CH_2.O.CH_2$ CH_2OH	106.10	$C_4H_{10}O_3$
31 Digallic acid, α	$(OH)_3C_6H_2.COO.C_6H_2(OH)_2$ $COOH$	322.15	$C_{14}H_{10}O_9$
32 Diglycerol	$C_6H_{14}O_5$	166.14	$C_6H_{14}O_5$
33 Diglycollamide acid	$NH:(CH_2.COOH)_2$	133.09	$C_4H_7O_4N$
34 Diglycollic acid	$O:(CH_2.COOH)_2$	134.07	$C_4H_6O_5$
35 Dihydro acrylic acid	$C_6H_6O_3$	126.08	$C_6H_6O_3$

Density $H_2O=1$.	Solubility in Water.	Solubility in Alcohol.	Solubility in Ether.	M.P. °C.	B.P. °C.	
		c.v.s.	s.	120		1
		v.s.	s.	135	285	2
		h.s.		114—115		3
				99—100		4
	v.s. C_6H_6	v.s.	v.s.	104—105		5
				67	280—282	6
				156		7
				98—99		8
				85		9
				116—117		10
		s.	s.	92—93		11
		s.		103—104		12
	h.s.s.	h.v.s.	s. $CHCl_3$	120		13
				96		14
				161		15
		s.	s.	170		16
	s.	s.	s.	204	d.	17
	s.	s.	s. ac.	105		18
0.7116/15°	v.s.	s.		−40	55.5/759mm.	19
0.939/18°	i.	s.	s.	−38.8	215.5	20
0.8622/18°	i.	s.	s.	liq.	182—183	21
				liq.	186	22
	1 : 2.8			80	subl. 50	23
0.8175/16.6°	1 : 24				102.7	24
$>H_2O$					85	25
	v.s.	c.v.s.				26
1.0415	s.	s.	s.	112—113	263	27
		v.s.	v.s.	74		28
	v.s.	v.s.		104	145—146	29
1.122/0°	s.	s.	s.		250	30
	s.	s.	i.		282 d.	31
	h.v.s.		i.		220—230/10	32
	1 : 41/5°	i.	i.	247.5		33
	s.	s.	s.	148	d.	34
	s.	s.			97/35mm.	35

	Name	Formula.	Formula Weight.	Empirical Formula.
1	Dihydro benzene, 1 : 2	$C_6H_6.H_2$	80.09	C_6H_8
2	— carveol, α	$C_{10}H_{18}O$	154.19	$C_{10}H_{18}O$
3	— carvone	$C_{10}H_{16}O$	152.18	$C_{10}H_{16}O$
4	— cymene	$C_{10}H_{14}.H_2$	136.18	$C_{10}H_{16}$
5	— naphthalene, 1 : 4	$C_{10}H_8.H_2$	130.13	$C_{10}H_{10}$
6	— quinoline	C_9H_9N	131.13	C_9H_9N
7	— resorcinol	$C_6H_6O_2.H_2$	112.09	$C_6H_8O_2$
8	Dihydroxy acetone	$(CH_2OH)_2:CO$	90.06	$C_3H_6O_3$
9	— anthracene, 1 : 8, chrysazol	$C_{14}H_8(OH)_2$	210.15	$C_{14}H_{10}O_2$
10	— —, 1 : 5, rufol	,,	210.15	,,
11	— benzene, *o*, pyrocatechol	$C_6H_4(OH)_2$	110.08	$C_6H_6O_2$
12	— —, *m*, resorcinol	,,	110.08	,,
13	— —, *p*, hydroquinone	,,	110.08	,,
14	— benzoic acid, 1. hydroxy salicylic	$(OH)_2:C_6H_3.COOH$ 2 : 5 : 1	154.08	$C_7H_6O_4$
15	2. protocatechoic	3 : 4 : 1	154.08	,,
16	3. dihydroxybenzoic	3 : 4 : 1	154.08	,,
17	— benzophenone, 2 :4′	$(C_6H_4OH)_2:CO$	214.15	$C_{13}H_{10}O_3$
18	— —, 4 : 4′	,, ,,	214.15	,,
19	— —, 3 : 3′	,, ,,	214.15	,,
20	— —, benzoyl pyrocatechol	$C_6H_5.CO.C_6H_3(OH)_2.\frac{1}{2}H_2O$	236.16	,,
21	— —, benzo resorcinol	,, ,,	214.15	,,
22	— cinnamic acid, 1 : 3 : 4	$(OH)_2:C_6H_3.C_2H_2.COOH$ $\frac{1}{2}H_2O$	189.12	$C_9H_8O_4$
23	— diphenylmethane	$(C_6H_4OH)_2:CH_2$, 4 : 4′	200.16	$C_{13}H_{12}O_2$
24	— naphthalene, 1 :4	$C_{10}H_6(OH)_2$	160.11	$C_{10}H_8O_2$
25	— —, 1 : 2	,,	160.11	,,
26	— —, 1 : 5	,,	160.11	,,
27	— —, 1 : 8	,,	160.11	,,
28	— —, 2 : 3	,,	160.11	,,
29	— —, 2 : 6	,,	160.11	,,
30	— —, 2 : 7	,,	160.11	,,
31	— quinone	$C_6H_2O_2(OH)_2$	140.06	$C_6H_4O_4$
32	— stearic acid, α β	$C_{18}H_{34}O_2(OH)_2$	316.28	$C_{18}H_{36}O_4$
33	— tartaric acid	$[C(OH)_2COOH]_2$	182.07	$C_4H_6O_8$
34	— terephthalic acid, 2 : 5	$C_6H_2(OH)_2(COOH)_2.2H_2O$	234.12	$C_8H_6O_6$

Density $H_2O=1$.	Solubility in Water.	Solubility in Alcohol.	Solubility in Ether.	M.P. °C.	B.P. °C.	
					80.5	1
0.927/20°				liq.	221	2
0.928/19°				liq.	221/758mm.	3
					174	4
				15.5	212	5
				220—226		6
	v.s.	v.s.	v.s.s.	104—106		7
	v.s.	h.s.	v.s.s.	68—75		8
		s.	s. alk.	d. 225		9
		s.	s. alk.	d. 265		10
1.375/15°	s.	s.	s.	105.5	245	11
1.2717/15°	86.4 :100/0°	s.	s.	111.6	276.5	12
1.326/15°	5.85 :100/15°	s.	s.	170.3	285	13
	h.s.	s.	s.	196	d.	14
1.542/4°	1 : 54/14°	v.s.	s.	200	d.	15
	h.s.	s.	s.	232—233		16
	h.s.s.	h.s.	s.	144		17
	h.s.	s.	s.	210		18
	s.	s.		162—163		19
	h.s.	s.	s. alk.	an. 145		20
	h.s.	s.	s.	144		21
	v.s.	v.s.	v.s.	d. 124		22
		s.	s.	158	subl.	23
	h.s.	h.s.	s.	173		24
	s.		s. alk.	60		25
	h.s.	s.	s.	250		26
	h.s.s.	s. C_6H_6	s.	140		27
	h.s.s.	s.	s.	159		28
	c.s.s.	s.	s.	215—216	subl.	29
	h.s.	s.s.	s. C_6H_6	190	subl.	30
	c.s.s.	v.s.	s.s.		215—220	31
		0.6 : 100 /19°	0.2 : 100 /18°	126		32
	v.s.			98 d.		33
	h.s.	s.s.	s.s.	d.		34

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Dihydroxy toluene 1. homopyrocatechol, 1 : 3 : 4	$CH_3.C_6H_3:(OH)_2$	124.10	$C_7H_8O_2$
2 2. orcinol, 1 : 3 : 5	,, ,, $.H_2O$	142.08	,,
3 3. iso-orcinol, β	,, ,,	124.10	,,
4 4. cresorcinol, 1 : 2 : 4	,, ,,	124.10	,,
5 5. hydrotoluquinone, 1 : 2 : 5	,, ,,	124.10	,,
6 — xylene, 4 : 6 : 1 : 3	$C_6H_2(CH_3)_2(OH)_2$	138.12	$C_8H_{10}O_2$
7 — —, 2 : 5 : 1 : 4	,, ,,	138.12	,,
8 — —, 2 : 6 : 1 : 4	,, ,,	138.12	,,
9 Di-iodo benzene, *o*	$C_6H_4I_2$	329.90	$C_6H_4I_2$
10 — — —, *m*	,,	329.90	,,
11 — — —, *p*	,,	329.90	,,
12 Di-iso butylamine	$(C_4H_9)_2:NH$	129.20	$C_8H_{19}N$
13 — — butylene	$(CH_3)_2:C:CH.C(CH_3)_3$	112.17	C_8H_{16}
14 — — butyl ketone	$C_4H_9.CO.C_4H_9$	142.19	$C_9H_{18}O$
15 — — propyl ketone	$C_3H_7.CO.C_3H_7$	114.15	$C_7H_{14}O$
16 Dimethyl amine	$(CH_3)_2:NH$	45.08	C_2H_7N
17 — aniline	$C_6H_5.N:(CH_3)_2$	121.14	$C_8H_{11}N$
18 — anthracene, α	$CH_3.C_6H_3.C_2H_2.C_6H_3.CH_3$	206.19	$C_{16}H_{14}$
19 — —, β 1 : 3	$C_{14}H_8(CH_3)_2$	206.19	,,
20 — ethyl benzene, 1 : 3 : 5	$C_6H_3(CH_3)_2C_2H_5$	134.16	$C_{10}H_{14}$
21 — furane, 2 : 5	$C_4H_2O(CH_3)_2$	96.09	C_6H_8O
22 — hydro quinone	$C_6H_4(OCH_3)_2$	138.12	$C_8H_{10}O_2$
23 — hypophosphorous acid	$(CH_3)_2OH.PO$	94.1l	$C_2H_7O_2P$
24 — naphthalene, α 1 : 4	$C_{10}H_6(CH_3)_2$	156.16	$C_{12}H_{12}$
25 — —, *isom.*	,,	156.16	,,
26 — naphthylamine, α	$C_{10}H_7.N(CH_3)_2$	171.17	$C_{12}H_{13}N$
27 — —, β	,, ,,	171.17	,,
28 — nitrosamine	$(CH_3)_2:N.NO$	74.08	$C_2H_6ON_2$
29 — phosphine	$(CH_3)_2:PH$	62.11	C_2H_7P
30 — pyrazine	CH ⟨ $C(CH_3).N$ / $N:C(CH_3)$ ⟩ CH	108.11	$C_6H_8N_2$
31 — pyridine, see	Lutidine		
32 — pyrrole, 2 : 5	$C_4H_2N(CH_3)_2$	95.11	C_6H_8N
33 — resorcinol	$C_6H_4(OCH_3)_2$	138.12	$C_8H_{10}O_2$
34 — sulphate	$SO_2(OCH_3)_2$	126.12	$C_2H_6O_4S$

Density $H_2O=1$.	Solubility in Water.	Solubility in Alcohol.	Solubility in Ether.	M.P. °C.	B.P. °C.	
	v.s.	v.s.	v.s.	65	251	1
1.29	s.	s.	s.	58, an. 107	287—290	2
	s.	s.	s.	87	260	3
	v.s.	v.s.	v.s.	103—104	267—270	4
	v.s.	v.s.	v.s.	126—126.5	subl.	5
	v.s.	v.s.	v.s.	124.5—125	276—279	6
	h.s.	v.s.	v.s.	217	subl.	7
	s.	s.		163	277-280	8
		s.		27	286.5/751	9
		s.		40.4	284.7/756.5	10
		s.		128	285	11
	v.s.s.				139—140	12
0.734/0°					102.5/756	13
0.833/20°	i.			liq.	164—166/741	14
0.8062/20°				liq.	125—126	15
0.6865/—5.8°	s.	s.		liq.	7.3	16
0.9555/20°		s.		2.5	193.1	17
	i.	s.	s.	224—225		18
	i.	s.		202—203		19
0.861/20°				−20	185	20
0.9026/17.7°	i.	m.	s.	liq.	93	21
	i.		s. C_6H_6	55—56	205	22
	s.	s.	s.	76		23
1.0176/20°					262—264	24
					264—266	25
1.0423/20°	i.	s.	s.	liq.	274—275/711	26
		s.		46—47.7	305	27
					148.5/724	28
<H_2O	i.			liq.	25	29
0.9896/18°	m.	m.	m.	15	155	30
						31
0.9353/19.8°	v.s.s.	v.s.	v.s.	oil	165/752mm.	32
1.0803/0°	v.s.s.	s.	s.	−17	214—215	33
1.324/25°				liq.	188.3—188.6	34

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Dimethyl thetine	$CH_2.S(SCH_3)_2$ $CO.O$	120.14	$C_4H_8O_2S$
2 — thiophene, 2 : 3	$C_4H_2S(CH_3)_2$	112.15	C_6H_8S
3 — —, 2 : 4	,, ,,	112.15	,,
4 Dinaphthol, *a*	$OH.C_{10}H_6.C_{10}H_6.OH$	286.21	$C_{20}H_{14}O_2$
5 —, *β*	,, ,,	286.21	,,
6 Dinaphthyl	$(C_{10}H_7)_2$	254.21	$C_{20}H_{14}$
7 — amine, 2 : 2′	$(C_{10}H_7)_2:NH$	269.23	$C_{20}H_{15}N$
8 — ether, 1 : 1′	$(C_{10}H_7)_2:O$	270.21	$C_{20}H_{14}O$
9 — —, 1 : 2′	,, ,,	270.21	,,
10 — —, 2 : 2′	,, ,,	270.21	,,
11 — ketone, *a*, 1 : 2′	$(C_{10}H_7)_2:CO$	282.22	$C_{21}H_{14}O$
12 — —, *β*	,, ,,	282.22	,,
13 — —, *γ*	,, ,,	282.22	,,
14 — methane, *a*	$(C_{10}H_7)_2:CH_2$	268.23	$C_{21}H_{16}$
15 — —, *β*	,, ,,	268.23	,,
16 Dinicotinic acid, see	Pyridine carboxylic acid		
17 Dinitro aniline, 1 : 2 : 4	$C_6H_3(NO_2)_2NH_2$	183.10	$C_6H_5O_4N_3$
18 — —, 1 : 2 : 6	,, ,,	183.10	,,
19 — anthraquinone, 1 : 8	$C_{14}H_6O_2(NO_2)_2$	298.14	$C_{14}H_6O_6N_2$
20 — —, 2 : 7	,, ,,	298.14	,,
21 — benzene, *o*	$C_6H_4(NO_2)_2$	168.08	$C_6H_4O_4N_2$
22 — —, *m*	,, ,,	168.08	,,
23 — —, *p*	,, ,,	168.08	,,
24 — benzoic acid, 1 : 2 : 5	$C_6H_3.COOH(NO_2)_2$	212.09	$C_7H_4O_6N_2$
25 — — —, 1 : 2 : 4	,, ,,	212.09	,,
26 — — —, 1 : 2 : 6	,, ,,	212.09	,,
27 — — —, 1 : 3 : 5	,, ,,	212.09	,,
28 — cresol, *p*	$C_6H_2(NO_2)_2(CH_3)OH$	198.10	$C_7H_6O_5N_2$
29 — dichlor benzene, 1 : 3 : 2 : 5	$C_6H_2(NO_2)Cl_2$	236.99	$C_6H_2O_4N_2Cl_2$
30 — diphenyl, 4 : 4′	$NO_2.C_6H_4.C_6H_4.NO_2$	244.14	$C_{12}H_8O_4N_2$
31 — —, 2 : 2′	,, ,,	244.14	,,
32 — diphenylamine, 2 : 4	$(C_6H_4.NO_2)_2:NH$	259.16	$C_{12}H_9O_4N_3$
33 — —, 4 : 4′	,, ,,	259.16	,,
34 — methane	$CH_2(NO_2)_2$	106.04	$CH_2O_4N_2$
35 — naphthalene, 1 : 5	$C_{10}H_6(NO_2)_2$	218.12	$C_{10}H_6O_4N_2$

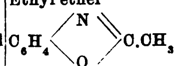
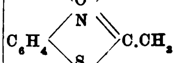
$H_2O=1$. Density	Water.	Alcohol.	Ether.	°C. M.P.	°C. B.P.	
	Solubility in					
	del.	s.		d.		1
0.9938/21°				liq.	136—137	2
0.9956/20°					137—138	3
	i.	s.	s.	300		4
	i.	s.	s.			5
			s.	180—182	subl.	6
	i.	s.s.	s. C_6H_6	170.5	471	7
	i.	h.s.	v.s.	109—110		8
				81	264/15mm.	9
				105	250/19mm.	10
		1 : 77	s., s. C_6H_6	135		11
		1 : 267		125.5		12
	s. $CHCl_3$	1 : 1250	v.s.s.	164.5		13
	s. $CHCl_3$	h. 1 : 15	s., s. C_6H_6	109	>360	14
		s.	s. C_6H_6	93		15
						16
	h.v.s.s.	s.		181		17
		h.s.s.		138—139		18
	v.s.s.	v.s.s.	v.s.s.	256—260	subl. d.	19
	s.h. acetic	s.s.	s.s.	280		20
1.59/18°	0.38 : 100 /100°	3.8 : 100 /25°		116.5	319/773.5	21
1.369/89.1°	i.	5.9 : 100 /24.6°		89.7	302.8	22
1.625/18°	0.18 : 100 /100°	h.s.		171—172	299/773mm.	23
	h.s.s.	v.s.	s. C_6H_6	177		24
				180		25
	h.v.s.			202	d.	26
	h.s.	s.	s.s.	206		27
				84		28
				104	312 d.	29
		c.s.s.		233		30
		h.s.		93.5		31
				153		32
		s.		214		33
					d.	34
		s.s.	s. C_6H_6	216	subl.	35

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Dinitro naphthalene, 1 : 8	$C_{10}H_6(NO_2)_2$	218.12	$C_{10}H_6O_4N_2$
2 — —, 1 : 3	,, ,,	218.12	,,
3 — naphthol, 1 : 2 : 4	$C_{10}H_5OH(NO_2)_2$	234.12	$C_{10}H_6O_5N_2$
4 — —, 1 : 2 : 6	,, ,,	234.12	,,
5 — phenol, 1 : 3 : 4	$C_6H_3OH(NO_2)_2$	184.08	$C_6H_4O_5N_2$
6 — —, 1 : 2 : 3	,, ,,	184.08	,,
7 — —, 1 : 2 : 4	,, ,,	184.08	,,
8 — —, 1 : 2 : 5	,, ,,	184.08	,,
9 — —, 1 : 2 : 6	,, ,,	184.08	,,
10 — resorcinol, 2 :4 :1 :3	$C_6H_2(NO_2)_2(OH)_2$	200.08	$C_6H_4O_6N_2$
11 — salicylic acid, 2 : 1 : 3 : 5	$C_6H_2OH(COOH)(NO_2)_2.H_2O$	246.11	$C_7H_4O_7N_2$
12 — — —, 4 : 1 : 3 : 5	,, ,,	228.09	,,
13 — tartaric acid	$(NO_3)_2C_2H_2(COOH)_2$	240.07	$C_4H_4O_{10}N_2$
14 — toluene, 1 : 2 : 4	$C_6H_3.(CH_3)(NO_2)_2$	182.10	$C_7H_6O_4N_2$
15 — —, 1 : 3 : 4	,, ,,	182.10	,,
16 — —, 1 : 3 : 5	,, ,,	182.10	,,
17 — xylene, 1 : 3 : 4 : 6	$C_6H_2(CH_3)_2(NO_2)_2$	196.12	$C_8H_8O_4N_2$
18 — —, 1 : 4 : 2 : 6	,, ,,	196.12	,,
19 — —, 1 : 4 : 2 : 3	,, ,,	196.12	,,
20 Dioctyl, see	Hexadecane		
21 Dioxindole	$C_6H_4\left\langle\begin{matrix}CH(OH)\\NH\end{matrix}\right\rangle CO$	149.11	$C_8H_7O_2N$
22 Diphenic acid	$(C_6H_4.COOH)_2$	242.15	$C_{14}H_{10}O_4$
23 Diphenol, α	$OH.C_6H_4.C_6H_4.OH$	186.14	$C_{12}H_{10}O_2$
24 —, β, 2 : 3′	,, ,,	186.14	,,
25 —, γ, 4 : 4′	,, ,,	186.14	,,
26 —, δ	,, ,,	186.14	,,
27 Diphenyl	$(C_6H_5)_2$	154.14	$C_{12}H_{10}$
28 — acetamidine	$CH_3.C(:N.C_6H_5).NH.C_6H_5$	210.20	$C_{14}H_{14}N_2$
29 — acetic acid	$(C_6H_5)_2:CH.COOH$	212.17	$C_{14}H_{12}O_2$
30 — amine	$(C_6H_5)_2:NH$	169.16	$C_{12}H_{11}N$
31 — benzene, *p*	$C_6H_4(C_6H_5)_2$	230.20	$C_{18}H_{14}$
32 — carbonate	$(C_6H_5O)_2CO$	214.15	$C_{13}H_{10}O_3$
33 — carboxylic acid, *o*	$C_6H_5.C_6H_4.COOH$	198.15	$C_{13}H_{10}O_2$
34 — — —, *p*	,, ,,	198.15	,,

Density $H_2O=1$.	Solubility in— Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
	1 : 100, $CHCl_3$	s.s.	s.s. C_6H_6	170	d.	1
		s.		144	subl.	2
	h.v.s.s.	s.	s., s. acetic	143		3
	h.v.s.	v.s.	v.s.	195 d.		4
	h. 1 : 21	c.v.s.s.	s.	134		5
	s.s.	h.s.	s.	144		6
				113–114		7
				105		8
				63–64		9
		s.		142	subl.	10
	h v.s	s	s.	an. 172—173	subl.	11
				248.5—249.5		12
	s.	s.	s			13
	i.	s.s.	s.s. CS_2	70.2		14
1.32	i.	s.s.	2.19 : 100, CS_2	69.5—71		15
	s.s.	c.s.	s.	88—91		16
		h.s.		93		17
		s.s.		124		18
		s.		90		19
						20
	c. 1 : 12, h. 1 : 6	c. 1 : 15, h. 1 : 10	s. alk.	180	d. 195	21
	h.s.	v.s.	v.s	228—229	subl.	22
	h.s.	s.	s.	123		23
	v.s.s.	s.	s.	190		24
	s.s.	s.	s.	272	subl.	25
	h.s.s.	s.	s.	161	342	26
1.165	c. 6.7 : 100	c. 10 : 100	s.	70.5	254.9	27
	m.	m.	m.	134		28
	h.s.	s.	s	118	268—271	29
1.159	s.s.	56 : 100 /19.5°	s.	54	302	30
	h.s. C_6H_6	h.s.s.	s	205	subl.	31
	i.	h.s.	s.	78	301—302	32
	h.s.s.	h.s.		110—111		33
	h.v.s.s.	s.	s.	224	subl.	34

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Diphenyl diacetylene	$C_6H_5.C\ :\ C.C\ :\ C.C_6H_5$	202.16	$C_{16}H_{10}$
2 — dicarboxylic acid, 2 : 2″	$(C_6H_4)_2(COOH)_2$	242.15	$C_{14}H_{10}O_4$
3 — ethane, *a a*	$CH_3.CH:(C_6H_5)_2$	182.18	$C_{14}H_{14}$
4 — formamidine	$C_6H_5N:CH.NH.C_6H_5$	196.18	$C_{13}H_{12}N_2$
5 — hydrazine	$(C_6H_5)_2:N.NH_2$	184.18	$C_{12}H_{12}N_2$
6 — methane	$(C_6H_5)_2:CH_2$	168.16	$C_{13}H_{12}$
7 — nitrosamine, see	Nitroso diphenylamine		
8 — sulphide	$(C_6H_5)_2S$	186.20	$C_{12}H_{10}S$
9 — sulphone	$(C_6H_5)_2SO_2$	218.20	$C_{12}H_{10}O_2S$
10 — thiocyanate, *iso.*	$C_{12}H_9N.CS$	211.21	$C_{13}H_9NS$
11 — tolymethane	$(C_6H_5)_2:CH.(C_6H_4.CH_3)$	258.24	$C_{20}H_{18}$
12 — urea, β	$NH_2.CO.N(C_6H_5)_2$	212.18	$C_{13}H_{12}ON_2$
13 Diphenylene oxide	$(C_6H_4)_2:O$	168.12	$C_{12}H_8O$
14 — ketone, see	Fluorenone		
15 Diphenylol, *p*	$C_6H_5.C_6H_4OH$	170.14	$C_{12}H_{10}O$
16 Dipicolinic acid, see	Pyridine carboxylic acid		
17 Dipyridine	$C_{10}H_{10}N_2$	158.15	$C_{10}H_{10}N_2$
18 Dipyridyl, 4 : 4′	$C_5H_4N.C_5H_4N$	156.13	$C_{10}H_8N_2$
19 Diquinoline	$C_{18}H_{14}N_2$	258.22	$C_{18}H_{14}N_2$
20 Diquinonyl, 6 : 6′	$C_{18}H_{12}N_2$	256.21	$C_{18}H_{12}N_2$
21 —, 2 : 7′	,,	256.21	,,
22 Diresorcinol, 3 :5 :3′ :5′	$(OH)_2C_6H_3.C_6H_3(OH)_2.2H_2O$	254.17	$C_{12}H_{10}O_4$
23 Dithio carbamic acid	$NH_2.CS_2H$	93.16	CH_3NS_2
24 — glycerin, see	Glycerin mercaptan		
25 Ditolyl	$(C_6H_4.CH_3)_2$	182.18	$C_{14}H_{14}$
26 — amine	$(C_6H_4.CH_3)_2:NH$	197.20	$C_{14}H_{15}N$
27 Diurea	$CO\left\langle {NH.NH \atop NH.NH} \right\rangle CO$	116.08	$C_2H_4O_2N_4$
28 Dodecane	$C_{12}H_{26}$	170.27	$C_{12}H_{26}$
29 Dodecylene	$C_{12}H_{24}$	168.25	$C_{12}H_{24}$
30 Dulcitol	$C_6H_8(OH)_6$	182.14	$C_6H_{14}O_6$
31 Durene, 1 : 2 : 4 : 5	$C_6H_2(CH_3)_4$	134.16	$C_{10}H_{14}$
32 Eicosane	$C_{20}H_{42}$	282.44	$C_{20}H_{42}$
33 Elæo-margaric acid	$C_{17}H_{30}O_2$	266.33	$C_{17}H_{30}O_2$
34 — stearic acid	,,	266.33	,,
35 Elaidic acid	$C_{17}H_{33}COOH$	282.36	$C_{18}H_{34}O_2$
36 Ellagic acid	$CO.C_6H(OH)_2.O$ $O.\ C_6H(OH)_2.CO$	338.15	$C_{14}H_6O_8$

Density H_2O=1.	Solubility in Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
		s.	s.	88		1
	i.	i.	i.	228—229	d.	2
				oil	286	3
	s.s.	s.	s. C_6H_6	138—139		4
	s.s.	s.	s.	127	220/50mm.	5
1.0126/11°	s. $CHCl_3$	s.	s.	27	260—261	6
						7
1.12/0°	i.	s.	m.	liq.	296/765mm.	8
	h.s.s.	h.s.	s., s. C_6H_6	124.5	376.4/722	9
			v.s.	58		10
	s. C_6H_6	c.s.s.	s.	59—59.5	>360	11
				187—188		12
	i.	v.s.	s.	85	287	13
						14
		v.s.	v.s.	161—162	305—308	15
						16
	h.s.	s.	s.	108	subl.	17
	h.v.s.	v.s.	v.s.	111—112	304.8	18
	i.	h.s.	s.	114		19
		s.		178		20
	i.	h.s.	s.s.	192.5	subl.	21
	h.v.s.		s.	310		22
	v.s.	v.s.	v.s.			23
						24
0.9172/121°	h.s.	s.	s.	5—7	286	25
				liq.	312/727.5	26
	c.s.s.	h.s.s.		270		27
0.7584/15°				-12	214	28
0.7620/15°				-31	96/15mm.	29
1.466/15°	1 : 39/15°	s.s.		188.5	275—280	30
		s.	s.	79—80	190	31
0.777/37°				37	205/15mm.	32
		s.	v.s.s.	48		33
		s.	v.s.	71		34
		v.s.	s.	54		35
1.667/18°	h.v.s.s.	s.s.	i.	d.		36

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Emodin	$C_{14}H_4O_2(CH_3)(OH)_3.H_2O$	288.18	$C_{15}H_{10}O_5$
2 Epichlorhydrin, *α*	$CH_2.O.CH.CH_2Cl$	92.52	C_3H_5OCl
3 —, *β*	$O.CH_2.CHCl.CH_2$	92.52	”
4 Epicyanhydrin	C_3H_5OCN	83.07	C_4H_5ON
5 Epi-iodohydrin	C_3H_5OI	183.98	C_3H_5OI
6 Erucic acid	$C_{22}H_{42}O_2$	338.45	$C_{22}H_{42}O_2$
7 Erythrin	$C_4H_8O_4(C_8H_7O_3)_2.\frac{1}{2}H_2O$	431.28	$C_{20}H_{22}O_{10}$
8 Erythrite, *meso.*	$C_4H_6(OH)_4$	122.10	$C_4H_{10}O_4$
9 Erythroxyanthraquinone	$C_6H_4:(CO)_2:C_6H_3OH(1)$	224.13	$C_{14}H_8O_3$
10 Ethane	C_2H_6	30.06	C_2H_6
11 Ethenol amine	$CH_2(OH).CH_2.NH_2$	61.08	C_2H_7ON
12 — aniline	$C_6H_5.NH.(C_2H_4OH)$	137.13	$C_8H_{11}ON$
13 — piperidine	$C_5H_{10}N.(C_2H_4OH)$	129.17	$C_7H_{15}ON$
14 Ether, see	Ethyl ether		
15 Ethenyl aminophenol		133.11	C_8H_7ON
16 — aminothiophenol		149.17	C_8H_7NS
17 — triethyl ether	$CH_3.C(OC_2H_5)_3$	162.18	$C_8H_{18}O_3$
18 — tricarboxylic acid	$C_2H_3(COOH)_3$	162.07	$C_5H_6O_6$
19 Ethyl acetamide	$CH_3.CO.NH.C_2H_5$	87.10	C_4H_9ON
20 — acetylene	$C_2H.C_2H_5$	54.07	C_4H_6
21 — alcohol	C_2H_5OH	46.06	C_2H_6O
22 — allophanate	$NH_2.CO.NH.COOC_2H_5$	132.10	$C_4H_8O_3N_2$
23 — amine	$C_2H_5.NH_2$	45.08	C_2H_7N
24 — aniline	$C_6H_5.NH.C_2H_5$	121.14	$C_8H_{11}N$
25 — anthracene	$C_6H_4:C_2H(C_2H_5):C_6H_4$	206.19	$C_{16}H_{14}$
26 — —, dihydro	$C_6H_4:C_2H_3(C_2H_5):C_6H_4$	208.21	$C_{16}H_{16}$
27 — benzene	$C_6H_5.C_2H_5$	106.12	C_8H_{10}
28 — benzoic acid, *o*	$C_2H_5.C_6H_4.COOH$	150.13	$C_9H_{10}O_2$
29 — — —, *m*	” ”	150.13	”
30 — — —, *p*	” ”	150.13	”
31 — bromide	C_2H_5Br	108.97	C_2H_5Br
32 — carbazole	$C_{12}H_8N.C_2H_5$	195.18	$C_{14}H_{13}N$
33 — carbonate	$CO(OC_2H_5)_2$	118.11	$C_5H_{10}O_3$
34 — carbostyril	$C_6H_4.C_2H(C_2H_5).NH.CO$	174.16	$C_{11}H_{11}ON$

Density $H_2O=1$.	Solubility in Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
	s.	s.	s. acetic.	256—257		1
1.2040/0°	i.			liq.	116.5/761	2
					132—134	3
	h.s.	s.		162		4
1.03/13°	i.				160—180	5
		v.s.		33—34	281/30mm.	6
	v.s.s.	s.	1 : 328	an. 145		7
1.452/17°	v.s.	s.s.	i.	120	330	8
	s.NaOH	s.	s.	190		9
	s.s.	s.		gas	-89/735	10
0.8827/7.5°				HCl salt 100		11
1.11/0°	v.s.s.	s.		liq.	280	12
	s.	s.		liq.	199	13
						14
	i.	s.		liq	201	15
	i.	s.		liq.	238	16
0.94/22°	h.d.				142	17
	s.	s.	s.	d. 159		18
			s. ac.		205	19
				liq.	18	20
0.7937/15°	m.		m.	− 117.6	77.8/753	21
	h.s.		s.s.	190	d.	22
0.6994/8°	m.	m.	m.	− 85.2	16.55	23
0.9625/20°				− 80	205—207	24
	i.	s.		60—61		25
1.049/18°	i.	m.	m.	oil.	320—323 d.	26
0.8759/20°	i.	m.	m.	− 92.8	135.8/758	27
1.050/15°	h.s.	s.	s.	68	subl.	28
	s.	s.		47		29
	h.s.	s.	s.	112		30
1.450/15°	s.s.	m.	m	− 116	38.4	31
		h.s.	v.s.	67—68		32
0.9762/20°	i.	s.		liq.	126.4	33
				168		34

Name.	Formula.	Weight. Formula	D:Air=1 Water=1
1 **Ethyl carbylamine**	$C_2H_5.NC$	55.07	C_3H_5N
2 — chloride	C_2H_5Cl	64.51	C_2H_5Cl
3 — chloroformate	$Cl.COO.C_2H_5$	108.56	$C_3H_5O_2Cl$
4 — crotonic acid	$CH_3.C_2H(C_2H_5)COOH$	114.11	$C_6H_{10}O_2$
5 — cyanate	$N:C.OC_2H_5$	71.07	C_3H_5ON
6 — —, *iso*	$CO:N.C_2H_5$	71.07	..
7 — diphenylamine	$(C_6H_5)_2:N.C_2H_5$	197.20	$C_{14}H_{15}N$
8 — diphenylphosphine	$(C_6H_5)_2:P.C_2H_5$	214.23	$C_{14}H_{15}P$
9 — disulphide	$(C_2H_5)_2:S_2$	122.22	$C_4H_{10}S_2$
10 — dithiocarbonate	$CO:(SC_2H_5)_2$	150.23	$C_5H_{10}OS_2$
11 — ether	$C_2H_5.O.C_2H_5$	74.10	$C_4H_{10}O$
12 — fluoride	C_2H_5F	48.05	C_2H_5F
13 — formamide	$CHO.NH(C_2H_5)$	73.08	C_3H_7ON
14 — glycine	$CH_2(NH.C_2H_5)COOH$	103.10	$C_4H_9O_2N$
15 — glycollic acid	$CH_2(O.C_2H_5)COOH$	104.08	$C_4H_8O_3$
16 — hydrazine	$C_2H_5.NH.NH_2$	60.09	$C_2H_8N_2$
17 — hydroxylamine	$NH_2(C_2H_5)O$	61.08	C_2H_7ON
18 — isoamyl ether	$C_2H_5.O.C_5H_{11}$	116.16	$C_7H_{16}O$
19 — isobutyl ether	$C_2H_5.O.C_4H_9$	102.14	$C_6H_{14}O$
20 — isocyanide	$C_2H_5.NC$	55.07	C_3H_5N
21 — isopropyl ether	$C_2H_5.O.C_3H_7$	88.12	$C_5H_{12}O$
22 — iodide	C_2H_5I	155.97	C_2H_5I
23 — malonic acid	$C_2H_5.CH(COOH)_2$	150.11	$C_5H_8O_4$
24 — mercaptan	$C_2H_5.SH$	62.12	C_2H_6S
25 — methyl acetic acid	$C_2H_5.CH(CH_3).COOH$	102.11	$C_5H_{10}O_2$
26 — — aceto-acetate	$CH_3CO.CH(CH_3).COOC_2H_5$	144.13	$C_7H_{12}O_3$
27 — — benzene, *o*	$C_2H_5.C_6H_4.CH_3$	120.14	C_9H_{12}
28 — — —, *m*	,, ,,	120.14	,,
29 — — —, *p*	,, ,,	120.14	,,
30 — — glyoxalin	$C_4H_5.N_2.C_2H_5$	110.13	$C_6H_{10}N_2$
31 — — ketone	$C_2H_5.CO.CH_3$	72.08	C_4H_8O
32 — — protocatechuic aldehyde	$C_6H_3(CHO)(OCH_3)(OC_2H_5)$	180.15	$C_{10}H_{12}O_3$
33 — — sulphide	$C_2H_5.S.CH_3$	76.14	C_3H_8S
34 — monothio carbonate	$CS(OC_2H_5)_2$	134.17	$C_5H_{10}O_2S$
35 — naphthalene, *α*	$C_{10}H_7.C_2H_5$	156.16	$C_{12}H_{12}$
36 — —, *β*	,, ,,	156.16	,,
37 — naphthylamine, *α*	$C_{10}H_7.NH.C_2H_5$	171.17	$C_{12}H_{13}N$
38 — —, *β*	,, ,,	171.17	,,
39 — naphthyl ether, *α*	$C_{10}H_7.O.C_2H_5$	172.16	$C_{12}H_{14}O$

Density $H_2O=1$.	Solubility in Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
0.7591/4°				liq.	78	1
0.921/0°	2 : 100	m.	m.	– 141.6	12.5	2
1.139/15°	d.			liq.	94	3
	v.s.s.	s.		39.5	subl.	4
0.89	i.			liq.	d.	5
0.8981	h.s.	s.	s.		60	6
		s.		liq.	285—287	7
		s.	s. C_6H_6	liq.	293	8
0.933/20°	v.s.s.				153/730	9
1.085/19°					196—197	10
0.7201/15°	1 : 12/17.5°	m.		– 117.6	34.6	11
1.7	s.	v.s. (abs.)			– 32	12
0.952/21°					199	13
	s.	s.		d. > 160		14
				liq.	206—207	15
	v.s.	v.s.	s.		99.5/709	16
0.8827/7.5°	m.	m.	m.		59—60	17
0.764/18°					112	18
0.7507					79	19
0.7591/4°	v.s.				78.1	20
0.7447/0°					54	21
1.9433/15°	s.s.	s.	s.	– 108.5	72.3	22
	53 :100/0°	s.	s.	110	160 d.	23
0.8391/20°	1.5 :100	s.		– 22	35.5—36.1	24
0.938/24°				liq.	175	25
1.009/6°					189.7	26
0.873/16°	i.	s.	s.	<—17	158—159	27
0.869/20°	i.	s.	s.	liq.	158—159	28
0.865/21°	i.	s.	s.	liq.	161—162	29
0.982/15°	m.			liq.	212—213	30
0.8125/13°				– 85.9	79.6	31
	h.s.s.	s.s.	s.	73—74	subl.	32
0.837/20°					67	33
1.032/1°	i.	v.s.	v.s.		161—162	34
1.0184/10°					251—262	35
				– 14	251	36
					292—323/745mm.	37
				193	315—316	38
1.0746/0°				5.5	272	39

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Ethyl naphthyl ether, β	$C_{10}H_7.O.C_2H_5$	172.16	$C_{12}H_{12}O$
2 — nitrate	$C_2H_5.NO_3$	91.06	$C_2H_5O_3N$
3 — nitrite	$C_2H_5.NO_2$	75.06	$C_2H_5O_2N$
4 — nitrolic acid	$CH_3.C(NO_2):NOH$	104.06	$C_2H_4O_3N_2$
5 — ortho acetate	$CH_3.C(OC_2H_5)_3$	162.18	$C_8H_{18}O_3$
6 — ortho carbonate	$C(OC_2H_5)_4$	192.21	$C_9H_{20}O_4$
7 — ortho formate	$CH(OC_2H_5)_3$	148.16	$C_7H_{16}O_3$
8 — pelargonate	$C_9H_{17}O_2.C_2H_5$	187.24	$C_{11}H_{22}O_2$
9 — phenol, *o*	$C_2H_5.C_6H_4.OH$	122.12	$C_8H_{10}O$
10 — —, *p*	,,	122.12	,,
11 — phenyl acetylene	$C_6H_5.C:C.C_2H_5$	130.13	$C_{10}H_{10}$
12 — — carbaminate, phenyl urethane	$C_6H_5.NH.COOC_2H_5$	165.14	$C_9H_{11}O_2N$
13 — — carbinol	$C_6H_5.CHOH.C_2H_5$	136.14	$C_9H_{12}O$
14 — — hydrazine, α	$C_6H_5.N(C_2H_5).NH_2$	136.16	$C_8H_{12}N_2$
15 — — —, β	$C_6H_5.NH.NH.C_2H_5$	136.16	,,
16 — — ketone	$C_6H_5.CO.C_2H_5$	134.13	$C_9H_{10}O$
17 — — sulphone	$C_6H_5SO_2.C_2H_5$	170.18	$C_8H_{10}O_2S$
18 — — urea	$(C_2H_5)HN.CO.NH(C_6H_5)$	164.16	$C_9H_{12}ON_2$
19 — phosphine	$(C_2H_5)H_2P$	62.11	C_2H_7P
20 — propyl carbinal	$C_2H_5.CH_2CHOH.C_2H_5$	102.14	$C_6H_{14}O$
21 — — ether	$C_2H_5.O.C_3H_7$	88.12	$C_5H_{12}O$
22 — — ketone	$C_2H_5.CO.C_3H_7$	100.13	$C_6H_{12}O$
23 — pyridine, α	$C_5H_4N.C_2H_5$	107.12	C_7H_9N
24 — silicate	$Si(C_2H_5O)_4$	208.50	$C_8H_{20}O_4Si$
25 — sulphate	$(C_2H_5O)_2SO_2$	154.16	$C_4H_{10}O_4S$
26 — sulphide	$(C_2H_5)_2S$	90.16	$C_4H_{10}S$
27 — sulphinic acid	$C_2H_5.SO_2H$	94.12	$C_2H_6O_2S$
28 — sulphite	$(C_2H_5O)_2SO$	138.16	$C_4H_{10}O_3S$
29 — sulphochloride	$C_2H_5.SO_2Cl$	128.57	$C_2H_5O_2SCl$
30 — sulphone	$(C_2H_5)_2SO_2$	122.16	$C_4H_{10}O_2S$
31 — sulphonic acid	$C_2H_5.SO_2.OH$	110.12	$C_2H_6O_3S$
32 — sulphoxide	$(C_2H_5)SO$	106.16	$C_4H_{10}OS$
33 — sulphuric acid	$C_2H_5.HSO_4$	126.12	$C_2H_6O_4S$
34 — thiocyanate	$C_2H_5.SCN$	87.11	C_3H_5NS
35 — —, *iso.*	$C_2H_5.NCS$	87.11	,,
36 — thioximinate	$NH_2CS.COOC_2H_5$	137.15	$C_4H_7O_2NS$
37 — toluene, see	Ethyl methyl benzene		
38 — vinyl ether	$C_2H_5.O.C_2H_3$	72.08	C_4H_8O

Density H_2O=1.	Solubility in— Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
				37	274—275	1
1.1123/15.5°	i.			−112	86.3/728	2
0.9/15.5°	i.	m.		liq.	16.4	3
	s.		s.	88		4
0.94/22°					142	5
0.9197/18.5°				liq.	158—159	6
0.8971/18.8°	v.s.s.			liq.	146	7
0.8655/17.5°		s.		liq.		8
1.0371/0°				$<$—18	198—199/720	9
	i.	s.	s.	46	218.5—219	10
0.923/21°					201—203	11
				51—52	237—238	12
0.99/15°		s.	s.	liq.	210—211/750	13
1.018/15°				liq.	237	14
	s.s.	s.	s.	liq.	237—240/750	15
1.0141/15°				14.5	215/746	16
	c.s.s.	s.	s.	42	$>$300	17
		s.		99		18
$<H_2O$				liq.	25	19
0.8188/20°		s.			135	20
0.7545/0°					60	21
0.818/17.5°				liq.	123/763.4	22
0.9498/0°					148—150	23
0.933	d.				165	24
1.1837/19°	i.	h.d.		- 24.5	134.5/12mm.	25
0.8368/20°	i.			liq.	92/754mm.	26
			s. alk.			27
1.1063/0°		s.			66.5/26mm.	28
1.357/20°	d.			29	122 d.	29
	1:6.4			73—74	248	30
	del., v.s.	s.	s. alk.			31
	s.			4—6	88—89/15mm.	32
1.316/16°			s. alk.	liq.	d.	33
0.9953/23.4°	i.	m.	m.		141—142	34
1.019/0°	i.	s.	s.	− 5.9	132—133 /753mm.	35
	h.s.	v.s.	v.s.	63		36
						37
0.7635/14.5°	s.s.	s			35.5	38

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Ethyl xylene, 1:3:5	$C_2H_5.C_6H_3:(CH_3)_2$	134.16	$C_{10}H_{14}$
2 — —, 1 : 3 : 4	,, ,,	134.16	,,
3 Ethylene	$CH_2:CH_2$	28.04	C_2H_4
4 — bromide	$C_2H_4Br_2$	187.88	$C_2H_4Br_2$
5 —chlorhydrin	$CH_2Cl.CH_2OH$	80.50	C_2H_5OCl
6 — chloride	$C_2H_4Cl_2$	98.96	$C_2H_4Cl_2$
7 — cyanhydrin	$CH_2OH.CH_2CN$	71.07	C_3H_5ON
8 — cyanide	$C_2H_4(CN)_2$	80.07	$C_4H_4N_2$
9 —diamine	$C_2H_4(NH_2)_2.H_2O$	78.11	$C_2H_8N_2$
10 — diphenyldiamine	$C_2H_4(C_6H_5.NH)_2$	212.22	$C_{14}H_{16}N_2$
11 — disulphonic acid	$C_2H_4(SO_3H)_2$	190.18	$C_2H_6O_6S_2$
12 — ethylidine oxide	$CH_3.CH.O_2.C_2H_4$	88.08	$C_4H_8O_2$
13 — iodide	$C_2H_4I_2$	281.88	$C_2H_4I_2$
14 — mercaptan	$C_2H_4(SH)_2$	94.18	$C_2H_6S_2$
15 — nitrate	$C_2H_4(NO_3)_2$	152.06	$C_2H_4O_6N_2$
16 — nitrite	$C_2H_4(NO_2)_2$	120.06	$C_2H_4O_4N_2$
17 — oxide	C_2H_4O	44.04	C_2H_4O
18 — phenyl ether	$(C_6H_5O)_2C_2H_4$	214.18	$C_{14}H_{14}O_2$
19 — — sulphone	$(C_6H_5.SO_2)_2C_2H_4$	310.30	$C_{14}H_{14}O_4S_2$
20 — sulphide	$(C_2H_4S)_2$	120.20	$C_4H_8S_2$
21 — thiocyanate	$C_2H_4(SCN)_2$	144.19	$C_4H_4N_2S_2$
22 — urea	$CO:(NH.CH_2)_2$	86.08	$C_3H_6ON_2$
23 Ethylidene acetone	$CH_3.CO.CH:CH.CH_3$	84.09	C_5H_8O
24 — bromide	$CH_3.CHBr_2$	187.88	$C_2H_4Br_2$
25 — chloride	$CH_3.CHCl_2$	98.96	$C_2H_4Cl_2$
26 — cyanhydrin	$CH_3.CH(OH)CN$	71.07	C_3H_5ON
27 — urea	$CO:(NH)_2:CH.CH_3$	86.08	$C_3H_6ON_2$
28 — urethane	$C_2H_4(NH.COO.C_2H_5)_2$	204.19	$C_8H_{16}O_4N_2$
29 Eugenic acid	$C_6H_2(OH)(OCH_3)(C_3H_5)COOH$	208.15	$C_{11}H_{12}O_4$
30 Eugenol, 4 : 3 : 1	$C_6H_3(OH)(OCH_3)CH_2.CH:CH_2$	164.15	$C_{10}H_{12}O_2$
31 Eupittonic acid	$C_{19}H_8O_3(OCH_3)_6$	479.33	$C_{25}H_{26}O_9$
32 Euxanthic acid	$C_{13}H_{10}O_5$	246.15	$C_{13}H_{10}O_5$
33 Euxanthinic acid	$C_{19}H_{18}O_{10}.3H_2O$	460.29	$C_{19}H_{18}O_{10}$
34 Euxanthone	$OH.C_6H_3\left\langle {CO \atop O} \right\rangle C_6H_3.OH$	228.13	$C_{12}H_8O_4$
35 Evernic acid	$C_{17}H_{16}O_7$	332.21	$C_{17}H_{16}O_7$
36 Everniine	$C_6H_{14}O_7$	198.14	$C_6H_{14}O_7$

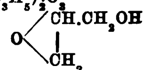
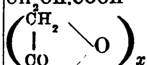
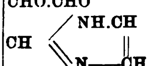
Density $H_2O=1$.	Solubility in Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
0.861/20°	i.		s.	liq.	185	1
0.8783/20°				liq.	183—184	2
	1 :8 vol.	2 : 1	2 : 1	− 169.5	− 103	3
2.1823/20°	i.	s.		9.95	131.6/769.8	4
1.24/8°	s.	s.	s.		128	5
1.2521/20°	i.	s.		− 40	57.5/751mm.	6
1.059/0°	m.	m.	2.3 : 100/15°	liq.	221/753mm.	7
1.23/45°	s.	s.	s.s.	54.5	158—160/20	8
0.970/15°	s.		v.s.s.	10	116	9
	i.	s.	s.	65		10
	del.	s.		94		11
1.002	1 :1.5				82.5	12
2.07		s.		81—82	d.	13
1.123/23°	s. alk.	s.		liq.	146	14
1.472		s.		liq.	d.	15
1.2156/0°	i.	s.	s.	37.5	subl.	16
0.896/0°	v.s.	v.s.	v.s.	liq.	13.5/746mm.	17
	i.	h.s.	s.	98.5		18
	i.	h.s.s.	s. acetic.	179.5—180		19
	i.	s.	s.	110	subl. 200	20
	h.s.	s.		90	d.	21
			s. $CHCl_3$	131		22
0.861/15°	s.				122—123/741	23
2.100/17.5°					112.5	24
1.1743/20°				− 96.7	57.5/751mm.	25
	s.	s.	s.		182—184 d.	26
	v.s.s.	s.s.	v.s.s.	154	d. 100	27
	h.s.	s.	s.	125—126	d.	28
	c.s.s.	s.	s	124		29
1.0703/14°	v.s.s.	s.	s.	liq.	247.5	30
	s. alk. to B	h.s.s. (abs.)	s. acetic.	d. 200		31
	h.s.	s. (abs.)	s. alk.	200—202		32
	h.s.	h.s.	v.s.	d. 160		33
	s. alk.	h.s.	s.s.	237—238		34
	h.s.s.	s.	s.	164—170		35
	v.s.	i.				36

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Everninic acid	$C_8H_7(OH)_2COOH.H_2O$	200.15	$C_9H_{10}O_4$
2 Fenchene	$C_{10}H_{16}$	136.18	$C_{10}H_{16}$
3 Fenchone	$C_{10}H_{16}O$	152.18	$C_{10}H_{16}O$
4 Ferulic acid, 3 : 4 : 1	$C_6H_3(OCH_3)OH.C_2H_2.COOH$	194.13	$C_{10}H_{10}O_4$
5 Fisetin	$OH.C_6H_3 \langle \begin{matrix} O—C.C_6H_3(OH)_2 \\ \Vert \\ CO.C(OH).4H_2O \end{matrix}$	358.22	$C_{15}H_{10}O_6$
6 Flavaniline	$C_{16}H_{12}N.NH_2$	234.21	$C_{16}H_{14}N_2$
7 Flaveanhydride	$CN.CS.NH_2$	86.11	$C_2H_2N_2S$
8 Flavone	$C_6H_4 \langle \begin{matrix} O—C.C_6H_5 \\ \Vert \\ CO.CH \end{matrix}$	222.16	$C_{15}H_{10}O_2$
9 Flavopurpurin, 1 :2 :6	$C_{14}H_5O_2(OH)_3$	256.13	$C_{14}H_8O_5$
10 Fluorane	$C_6H_4.C:(C_6H_4)_2:O$ $CO—O$	300.20	$C_{20}H_{12}O_3$
11 Fluoranthene	$C_{15}H_{10}$	190.16	$C_{15}H_{10}$
12 Fluor benzene	C_6H_5F	96.07	C_6H_5F
13 — benzoic acid	$C_6H_4F.COOH$	140.08	$C_7H_5O_2F$
14 Fluorene	$(C_6H_4)_2:CH_2$	166.15	$C_{13}H_{10}$
15 — alcohol	$(C_6H_4)_2:CHOH$	182.15	$C_{13}H_{10}O$
16 Fluorenone, diphenylene ketone	$(C_6H_4)_2:CO$	180.13	$C_{13}H_8O$
17 Fluoresceïn	$C_{20}H_{12}O_5$	332.10	$C_{20}H_{12}O_5$
18 Formaldehyde	$H.CHO$	30.02	CH_2O
19 Formamide	$H.CO.NH_2$	45.04	CH_3ON
20 — oxime	$CH(NH_2):NOH$	60.06	CH_4ON_2
21 Formanilide	$C_6H_5.NH.CHO$	121.10	C_7H_7ON
22 Formic acid	$H.COOH$	46.02	CH_2O_2
23 Formate, calcium	$(H.COO)_2Ca$	130.10	$C_2H_2O_4Ca$
24 —, copper	$(H.COO)_2Cu(.4H_2O)$	153.60	$C_2H_2O_4Cu$
25 —, lead	$(H.COO)_2Pb$	297.23	$C_2H_2O_4Pb$
26 —, sodium	$H.COONa$	68.01	CHO_2Na
27 —, allyl	$H.COO.C_3H_5$	86.07	$C_4H_6O_2$
28 —, *iso* amyl	$H.COO.C_5H_{11}$	116.13	$C_6H_{12}O_2$
29 —, ethyl	$H.COO.C_2H_5$	74.06	$C_3H_6O_2$
30 —, methyl	$H.COO.CH_3$	60.04	$C_2H_4O_2$
31 Formoxime	$CH_2:NOH$	45.04	CH_3ON
32 Formyl diphenylamine	$CHO.N(C_6H_5)_2$	197.16	$C_{13}H_{11}ON$

Density $H_2O=1$.	Solubility in Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
	h.s.	s.	s.	157		1
0.864/20°					158—160	2
0.9465/19°		s.		5—6	194—195	3
	h.s.	c.s.	s.s.	170	d.	4
		s.		330 d.		5
	v.s.s.	s.	s. C_6H_6	97		6
	s.	s.	v.s.	d. 87—90		7
	i.	s.	s.	97		8
	h.s.s.	c.s.	s.s.	> 330	459	9
		s.		182		10
	s. acetic	h.s.	s., s. CS_2	109—110	250—251/60	11
1.0236/20°					84.5	12
	h.s.	s.	s.	182		13
		h.s.	s.	115	294—295	14
		s.	s.	153		15
	i.	v.s.	v.s.		341.5	16
	h.s.s.	s.	s.	d.		17
	s.	s.		− 92	− 21	18
1.1337/14.1°	s.	s.		− 1	85—95/0.5	19
	s.	s.	s.	114—115	d.	20
	s.	s.	s.	50	271	21
1.2256/15°	m.	s.	s.	8.5	100.6	22
2.015	s.	i.				23
1.831	s.					24
4.56	1 :63/16°	i.				25
1.919	v.s.	s.				26
0.93/17.5°		s.		liq.	81—83	27
0.894/0°	1 :325/22°			liq.	130.4	28
0.9445/0°	11 :10	s.	s.	− 78.9	54.4	29
0.993/0°				− 100.4	32.2	30
	s.				84—85	31
	s.			73—74	210—220 in vac.	32

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Formyl hydrazine	$HCO.NH.NH_2$	60.06	CH_4ON
2 — thioaldehyde	$C_3H_6S_3$	138.24	$C_3H_6S_3$
3 Frangulin	$C_{21}H_{20}O_9$	416.26	$C_{21}H_{20}O_9$
4 Fraxine	$C_{16}H_{18}O_{10}$	370.22	$C_{16}H_{18}O_{10}$
5 Fulminate, mercuric	$(CNO)_2Hg.\frac{1}{2}H_2O$	293.65	$C_2O_2N_2Hg$
6 —, silver	$CNOAg$	149.90	$CNOAg$
7 Fulminuric acid	$C_3H_3N_3O_3$	129.07	$C_3H_3O_3N_3$
8 Fumaric acid	$C_2H_2(COOH)_2$	116.05	$C_4H_4O_4$
9 Furane	CH : CH O CH : CH	68.05	C_4H_4O
10 Furfural	$C_4H_3O.CHO$	96.06	$C_5H_4O_2$
11 Furfur alcohol	$C_4H_3O.CH_2OH$	98.07	$C_5H_6O_2$
12 — amide	$(C_5H_4O)_3N_2$	268.19	$C_{15}H_{12}O_3N_2$
13 Furfurin	$C_{15}H_{12}N_2O_3$	268.19	,,
14 Furfuryl amine	$C_4H_3O.CH_2.NH_2$	97.09	C_5H_7ON
15 Galactose, *l*	$C_6H_{12}O_6$	180.13	$C_6H_{12}O_6$
16 —, *d*	,,	180.13	,,
17 Galleïn	$C_{20}H_{10}O_7$	362.18	$C_{20}H_{10}O_7$
18 Gallic acid, 3 : 4 : 5 : 1	$C_6H_2(OH)_3COOH.H_2O$	188.10	$C_7H_6O_5$
19 Gallin	$C_{20}H_{14}O_7$	366.21	$C_{20}H_{14}O_7$
20 Gaultherin	$C_6H_{11}O_5.O.C_6H_4.COOCH_3$	314.21	$C_{14}H_{18}O_8$
21 Gaultherinic acid	$C_{36}H_{54}O_6$	582.61	$C_{36}H_{54}O_6$
22 Gentisin	$C_{14}H_{10}O_5$	258.15	$C_{14}H_{10}O_5$
23 Gluconic acid, *d*	$C_5H_6(OH)_5COOH$	196.13	$C_6H_{12}O_7$
24 Glucose	$C_6H_{12}O_6.H_2O$	198.15	$C_6H_{12}O_6$
25 —, anhydr.	$C_6H_{12}O_6$	180.13	,,
26 — phenylhydrazone, α	$C_6H_{12}O_5(N_2H.C_6H_5)$	270.22	$C_{12}H_{18}O_5N_2$
28 Glucosazone, α	$C_6H_{10}O_4(N_2H.C_6H_5)_2$	358.31	$C_{18}H_{22}O_4N_2$
28 Glucosoxime, α	$C_6H_{12}O_5:NOH$	195.14	$C_6H_{13}O_6N$
29 Glucosone	$C_4H_9O_4.CO.CHO$	178.11	$C_6H_{10}O_6$
30 Glucuronic acid	$CHO.(CHOH)_4.COOH$	194.11	$C_6H_{10}O_7$
31 Glutamine	$C_3H_5(NH_2)(CONH_2)COOH$	146.13	$C_5H_{10}O_3N_2$
32 Glutaminic acid, *i*	$C_3H_5(NH_2)(COOH)_2$	147.11	$C_5H_9O_4N$
33 Glutaric acid	$HOOC.(CH_2)_3.COOH$	132.09	$C_5H_8O_4$
34 Glyceric acid, α β	$CH_2OH.CHOH.COOH$	106.06	$C_3H_6O_4$
35 Glycerol	$C_3H_5(OH)_3$	92.08	$C_3H_8O_3$
36 — aldehyde	$CH_2OH.CHOH.CHO$	90.06	$C_3H_6O_3$

Density $H_2O=1$.	Solubility in— Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
				54		1
	h.s.s.	s.s.	s.s.	216	subl.	2
	i.	h.s.	h.s.	286		3
	h.s.	h.s.		190		4
4.42 (an.)	h.s.	s.		expl.		5
	1:36, h.			expl.		6
	s.	s.	s.	136—139		7
1.625	1:150/16.5°	s.	s.	286—287	200 subl.	8
0.9086/21.6	i.	s.	s.	liq.	31.6	9
1.1636/13.5°	1:11/13°	s.	s.	−36.5	158.5—159	10
1.1355/20°	s.	s.	s.	200 subl.	166—170/725	11
	c.i.	s.	s.	117	d. 250	12
	1:135/100°	v.s.	v.s.	116		13
$<H_2O$	m			liq.	145/754mm.	14
	s.	v.s.s.		162—163		15
	s.			168		16
	h.s.s.	v.s.	s.s., s. alk.	d.		17
1.694/4°	1:3/100°	28 : 100/15°	2.5 : 100/15°		253 d.	18
	s.	s.	s.			19
	s.	s.	i.	251—252	subl.	20
	s.s.	s.		195		21
	v.s.s.	v.s.s.	v.s.s.	267	300—400 subl & d.	22
	v.s.	i.				23
1.54—1.57	98:100/18°	s.		82		24
	s.	v.s.		146		25
	s.	h.s.	i	115, β 144		26
	i.	h.s.		145, β 204 d.		27
	v.s.	s.s.	i.	136—137		28
	s.	s.	i.			29
		s.		aq. 175		30
	1:25/16°	i.	i.			31
1.538	1:100/16°	s.s.	i.	198		32
1.1919/106.4°	1:1.2/14°	v.s.	v.s.	97.5	200/20mm.	33
	m.	m.	i.	liq.		34
1.2604/20°	m.	s.	i.	20	290	35
	s.s.	v.s.s.	v.s.s.	132		36

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Glycerol mercaptan, dithioglycerol	$C_3H_5(OH)(SH)_2$	124.20	$C_3H_8OS_2$
2 — —, monothioglycerol	$C_3H_5(OH)_2(SH)$	108.14	$C_3H_8O_2S$
3 — —, trithioglycerol	$C_3H_5(SH)_3$	140.26	$C_3H_8S_3$
4 — phosphoric acid	$C_3H_5(OH)_2OP(OH)_2$	156.13	$C_3H_9O_5P$
5 Glyceryl chloride	$C_3H_5Cl_3$	147.44	$C_3H_5Cl_3$
6 — ether	$(C_3H_5)_2O_3$	130.11	$C_6H_{10}O_3$
7 Glycide		74.06	$C_3H_6O_2$
8 Glycine, see	Amino acetic acid		
9 Glycocyamine	$C(NH)(NH_2)NH.CH_2.COOH$	117.09	$C_3H_7O_2N_3$
10 Glycol	$C_2H_4(OH)_2$	62.06	$C_2H_6O_2$
11 — acetate	$C_2H_4(OH)OOC.CH_3$	104.08	$C_4H_8O_3$
12 — amide	$CH_2OH.CONH_2$	75.06	$C_2H_5O_2N$
13 — di-acetate	$C_2H_4(OOC.CH_3)_2$	146.11	$C_6H_{10}O_4$
14 Glycollic acid	$CH_2OH.COOH$	76.04	$C_2H_4O_3$
15 Glycollide		(58.03)	
16 Glycol thiourea	$C_3H_4N_2SO$	116.13	$C_3H_4ON_2S$
17 Glyoxal	$CHO.CHO$	58.03	$C_2H_2O_2$
18 Glyoxaline		68.07	$C_3H_4N_2$
19 Glyoxime	$(CH:NOH).(CH:NOH)$	88.06	$C_2H_4O_2N_2$
20 Glyoxylic acid	$CHO.COOH.H_2O$	92.05	$C_2H_2O_3$
21 Guaiacol, 1 : 2	$C_6H_4(OH)OCH_3$	124.10	$C_7H_8O_2$
22 Guanidine, carbamidine	$NH:C:(NH_2)_2$	59.08	CH_5N_3
23 Guanine	$C_5H_5N_5O$	151.12	$C_5H_5ON_5$
24 Hæmateïn	$C_{16}H_{12}O_6$	300.18	$C_{16}H_{12}O_6$
25 Hæmatin	$Fe(C_{16}H_{16}N_2O_2)_2$	592.30	$C_{32}H_{32}O_4N_4Fe$
26 Hæmatoxylin	$C_{16}H_9O(OH)_5.3H_2O$	356.24	$C_{16}H_{14}O_6$
27 Helicin	$C_{13}H_{16}O_7.\frac{3}{4}H_2O$	297.71	$C_{13}H_{16}O_7$
28 Heliotropin, see	Piperonal		
29 Hemimellitic acid, 1 : 2 : 3	$C_6H_3(COOH)_3.2H_2O$	246.12	$C_9H_6O_6$
30 Hempinic acid, 3 : 4 : 1 : 3	$C_6H_2(OCH_3)_2(COOH)_2.2H_2O$	262.16	$C_{10}H_{10}O_6$
31 — —, 4 : 5 : 1 : 2	„ „	226.13	„

Density $H_2O=1$.	Solubility in— Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
1.34	i.	s.	i.	liq.		1
	s.s.	s.	i.	liq.		2
1.29	i.	s.	i.	liq.		3
1.39	s., h.d.	s.		d.		4
1.417/15°				liq.	154—156	5
1.16/16°	m.	m.	m.	liq.	171—172	6
1.165/0°	m.	m.	m.		162/751mm.	7
						8
	1:227/14.5°	i.	i.	− 11.2		9
1.1098/25°	m.	m.	i.	− 17.4	197/260mm.	10
$>H_2O$	m.	m.		liq.	182	11
	s.	s.s.		117—118		12
$>H_2O$	1:7	s.	s.	liq.	186—187	13
	s.	m.	m.	80	d.	14
	h.v.s.s.			220		15
	h.s.	i.	i.	d. 200		16
	v.s.	v.s.	s.	15	51	17
	s.	s.	s.	88—89	255	18
	h.s.	s.	s.	178	subl.	19
	s.		vol. steam.	syrup.		20
1.1385/15°	1:60/15°	s.	s.	32	205	21
	s.					22
	i.			d.		23
	s.s.	s.s.	s.s.			24
	i.	i.	i.			25
	h.s.	s.	s.	100—120		26
	h.v.s.	s.	i.	an. 175		27
						28
	3.15:100/19°		s.	196 d.		29
	c.s.s.	s.		184—185 d.		30
				178		31

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Hempinic acid, 5 :6 :1 :2	$C_6H_2(OCH_3)_2(COOH)_2$	226.13	$C_{10}H_{10}O_6$
2 Heptamethylene	C_7H_{14}	98.15	C_7H_{14}
3 Heptane, 1 norm.	$CH_3.(CH_2)_5.CH_3$	100.16	C_7H_{16}
4 —, 2. ethyl amyl	$CH_3.(CH_2)_3.CH:(CH_3)_2$	100.16	,,
5 —, 3. triethyl methane	$CH(C_2H_5)_3$	100.16	,,
6 —, 4. dimethyl diethyl methane	$(CH_3)_2:C:(C_2H_5)_2$	100.16	,,
7 Heptine, œnanthine	$CH_3(CH_2)_4.C : CH$	96.13	C_7H_{12}
8 Heptyl alcohol, 1 nor.	$C_7H_{15}OH$	116.16	$C_7H_{16}O$
9 ——, 2. dipropyl carbinol	$CH_3.(CH_2)_2.CHOH.(CH_2)_2.CH_3$	116.16	,,
10 — —, 3. di-isoproyyl carbinol	$(CH_3)_2:CH.CHOH.CH:(CH_3)_2$	116.16	,,
11 — —, 4. triethyl carbinol	$(C_2H_5)_3C.OH$	116.16	,,
12 — —, 5. dimethyl isobutyl carbinol	$(CH_3)_2:COH.CH_2.CH:(CH_3)_2$	116.16	,,
13 — —, 6. pentamethyl ethol	$(CH_3)_5C_2OH$	116.16	,,
14 — aldehyde, œnanthol	$C_6H_{13}.CHO$	114.15	$C_7H_{14}O$
15 Heytylene, norm.	C_7H_{14}	98.15	C_7H_{14}
16 Heptylic acid, norm.	$C_6H_{13}.COOH$	130.15	$C_7H_{14}O_2$
17 — —, iso	,, ,,	130.15	,,
18 Heptylate, ethyl	$CH_3.(CH_2)_5.COOC_2H_5$	158.19	$C_9H_{18}O_2$
19 Heptylic anhydride	$(C_6H_{13}.CO)_2:O$	242.28	$C_{14}H_{26}O_3$
20 Hesperidin	$C_{22}H_{26}O_{12}$	482.32	$C_{22}H_{26}O_{12}$
21 Hexa chlor benzene	C_6Cl_6	285.39	C_6Cl_6
22 — — ethane	C_2Cl_6	236.77	C_2Cl_6
23 — decane, dioctyl	$C_{16}H_{34}$	226.35	$C_{16}H_{34}$
24 — ethyl benzene	$C_6(C_2H_5)_6$	246.33	$C_{18}H_{30}$
25 — hydro benzene	$C_6H_6(H_6)$	84.13	C_6H_{12}
26 — — benzoic acid	$C_6H_5(H_6)COOH$	128.13	$C_7H_{12}O_2$
27 — — bipyridyl, see	Nicotidine		
28 — — cumene	$C_9H_{12}(H_6)$	126.19	C_9H_{18}
29 — — cymene	$CH_3.C_6H_4(H_6).C_3H_7$	140.21	$C_{10}H_{20}$
30 — — phenol	$C_6H_5(H_6)OH$	100.13	$C_6H_{12}O$
31 — — salicylic acid	$OH.C_6H_4(H_6)COOH$	144.13	$C_7H_{10}O_3$
32 — — tolune	$C_6H_5(H_6)CH_3$	98.15	C_7H_{14}
33 — — *m* xylene	$C_6H_4(H_6)(CH_3)_2$	112.17	C_8H_{16}

Density $H_2O=1$.	Solubility in Water.	Solubility in Alcohol.	Solubility in Ether.	M.P. °C.	B.P. °C.	
				180		1
0.8094/20°				- 13 to —12	117—117.5 /743mm.	2
0.6886/15°		s.	s.	liq.	97.5—98.5	3
0.6819/17°		s.	s.	liq.	90.3	4
0.689/27°		s.	s.	liq.	95—98	5
0.711/0°		s	s.	liq.	87	
0.8031/20°				liq.	110—112	
0.830/16°	i.	s.	s.	- 35.5	172.5—173	8
0.8200/20°		s.	s.	liq.	154—155	9
0.8288/20°	v.s.s.	s.	s.	liq.	131—132	10
0.8402/20°	s.s.	s.	s.	liq.	143—144	11
	s.s.	s.	s.	liq.	130—133	12
		s.	s.	17	131	13
0.827/17°	s.s.	s.		liq.	155	14
0.703/19°		s.		liq.	98—99	15
0.9345/0°		s.		- 12	221.5	16
	1 : 100 c.			liq.	211.5/746	17
0.8716/20°				liq.	188	18
0.92/11°				17	268—271	19
	1 :5000 h.	s.s.	i.	d. 251		20
1.569/236°	s. C_6H_6.	h.s.s.	s.s.	227	326	21
2.011	i.	s.	s.		187	22
0.7754/18°		m.	m.	20	287.5	23
	i.	s.	v.s.	129	305	24
0.7287/20°				6.5	80.7	25
	s.s.	s.	s.	30	232—233	26
						27
0.787/20°					137	28
0.8116/17°				liq.	153—158	29
	1 : 28 c.			25	161.1	30
	s.	s.	s.	111		31
0.772/4°					101	32
0.78/0°					119.5—120	33

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Hexa methyl benzene	$C_6(CH_3)_6$	162.20	$C_{12}H_{18}$
2 — methylene tetramine	$(CH_2)_6N_4.6H_2O$	248.27	$C_6H_{12}N_4$
3 Hexane, 1. norm.	$CH_3.(CH_2)_4.CH_3$	86.14	C_6H_{14}
4 —, 2. ethyl isobutyl	$CH_3.(CH_2)_2.CH:(CH_3)_2$	86.14	,,
5 —, 3. di-isopropyl	$(CH_3)_2:CH.CH:(CH_3)_2$	86.14	,,
6 —, 4. trimethyl ethyl methane	$(CH_3)_3C.(C_2H_5)$	86.14	,,
7 Hexa nitro diphenyl-amine	$[C_6H_2(NO_2)_3]_2NH$	439.17	$C_{12}H_5O_{12}N_7$
8 — oxy benzene	$C_6(OH)_6$	174.08	$C_6H_6O_6$
9 Hexene	$C_6H_6.H_4$	82.11	C_6H_{10}
10 Hexine, diallyl	$CH_2:CH.CH_2.CH_2.CH:CH_2$	82.11	,,
11 Hexyl alcohol, 1. nor.	$CH_3.(CH_2)_4.CH_2OH$	102.14	$C_6H_{14}O$
12 — —, 2. methyl butyl carbinol	$CH_3.CHOH.(CH_2)_3.CH_3$	102.14	,,
13 — —, 3. ethyl propyl carbinol	$C_2H_5.CHOH.(CH_2)_2.CH_3$	102.14	,,
14 — —, 4. pinacolyl alcohol	$(CH_3)_3C.CHOH.CH_3$	102.14	,,
15 — —, 5. dimethyl propyl carbinol	$(CH_3)_2:COH.(CH_2)_3CH_3$	102.14	,,
16 — —, 6. dimethyl iso propyl carbinol	$(CH_3)_2:COH.CH:(CH_3)_2$	102.14	,,
17 — —, 7. diethyl methyl carbinol	$(C_2H_5)_2:COH.CH_3$	102.14	,,
18 — aldehyde	$(CH_3)_2:CH.(CH_2)_2.CHO$	100.13	$C_6H_{12}O$
19 Hexylene, β	$CH_3.(CH_2)_2.CH:CH.CH_3$	84.13	C_6H_{12}
20 — glycol, 1. norm.	$CH_3.(CH_2)_3.CHOH.CH_2OH$	118.14	$C_6H_{14}O_2$
21 — —, 2. diallyl hydrate	$(CH_3.CH.CH_2OH)_2$	118.14	,,
22 — —, 3. pinacone	$(CH_3)_2:(C.OH)_2:(CH_3)_2$	118.14	,,
23 — iodide	$C_6H_{12}I_2$	337.94	$C_6H_{12}I_2$
24 Hippuric acid	$C_6H_5.CO.NH.CH_2COOH$	179.14	$C_9H_9O_3N$
25 Homatropine	$C_{16}H_{21}NO_3$	275.27	$C_{16}H_{21}O_3N$
26 Homocinchonine	$C_{19}H_{22}N_2O$	294.29	$C_{19}H_{22}ON_2$
27 Homopyrrole, see	Methyl pyrrole		
28 Homosalicylic acid, see	Hydroxyl toluic acid		
29 Hydantoïc acid	$NH_2.CO.NH.CH_2.COOH$	118.08	$C_3H_6O_3N_2$

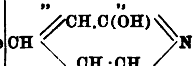
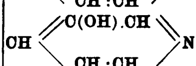
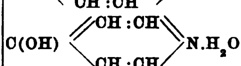
Density $H_2O=1$.	Solubility in Water.	Solubility in Alcohol.	Solubility in Ether.	M.P. °C.	B.P. °C.	
		s.s.	v.s. C_6H_6	164 subl	264	1
	s.	1 : 14 C., 1 : 7 h.	s. ac.	15	d.	2
0.6630/17°		s.	s.	S.P. —94.3	68.8	3
0.7011/0°		s.	s.	liq.	62	4
0.67/17°		s.	s.	liq.	58.1	5
		s.	s.	liq.	49.5	6
	i.	i.	s. alk.	238 d.		7
	s.s.	s.s.	s.s	200 d.		8
0.8102/20°					83—84	9
0.6983/12°				liq.	59	10
0.8204/20°	s.s.	s.		liq.	157.2/741	11
0.8327/0°	v.s.s.	s.		liq.	136	12
0.8188/20°	v.s.s.	s.		liq.	135	13
0.8347/0°		s.		4	121—123	14
		s.		4	120—125	15
0.8232/19°	s.	s.		- 35	117—119 /740mm.	16
0.8237/20°		s.			121—122.5	17
	s.s.	s.		liq.	121/743	18
0.6997/0°				- 98.5	67.7—68.1	19
0.967/0°	s.	s.	s.	liq.	207	20
0.9638/0°				liq.	212—215	21
0.96718/15°	h.s.	h.s.		43—44	171—172	22
2.024/0°				liq.	d.	23
1.308	h.s.	h.s.	s.s.	189	d.	24
	s.s.			99—100		25
	s.s.	1 : 140/10°	1 :371/10°	257—257		26
						27
						28
	c.s.s.	h.s.	v s.s.	153—156 d.		29

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Hydantoïn	$CO\genfrac{<}{}{0pt}{}{NH.CH_2}{NH.CO}$	100.07	$C_3H_4O_2N_2$
2 Hydracetamide	$(CH_3.CH)_3N_2$	112.15	$C_6H_{12}N_2$
3 Hydracrylic acid	$CH_2OH.CH_2.COOH$	90.06	$C_3H_6O_3$
4 Hydratropic acid	$C_6H_5.CH(CH_3)COOH$	150.13	$C_9H_{10}O_2$
5 Hyrazo benzene	$C_6H_5.NH.NH.C_6H_5$	148.18	$C_{12}H_{12}N_2$
6 — benzoic acid, *o*	$(NH.C_6H_4.COOH)_2$	272.19	$C_{14}H_{12}O_4N_2$
7 — — —, *m*.	,, ,,	272.19	,,
8 — toluene, *o*	$CH_3.C_6H_4.NH.NH.C_6H_4\ CH_3$	212.22	$C_{14}H_{16}N_2$
9 — —, *m*	,, ,,	212.22	,,
10 — —, *p*	,, ,,	212.22	,,
11 Hydrindene, 2 : 3	$C_6H_4:(CH_2)_3$	118.13	C_9H_{10}
12 Hydrindone, 1 : 2 : 3	$C_6H_4\genfrac{<}{>}{0pt}{}{CH_2}{CO}CH_2$	132.11	C_9H_8O
13 ——, 2 : 2 : 3	$C_6H_4\genfrac{<}{>}{0pt}{}{CH_2}{CH_2}CO$	132.11	,,
14 Hydro-acridine, 5 : 10	$C_6H_4\genfrac{<}{>}{0pt}{}{CH_2}{NH}C_6H_4$	181.16	$C_{13}H_{11}N$
15 — anthranol, 10 :9 :10	$CH_2\genfrac{<}{>}{0pt}{}{C_6H_4}{C_6H_4}CHOH$	196.17	$C_{14}H_{12}O$
16 — benzamide	$(C_6H_5.CH)_3N_2$	298.27	$C_{21}H_{18}N_2$
17 — benzoin	$C_6H_5.(CHOH)_2.C_6H_5$	214.18	$C_{14}H_{14}O_2$
18 — carbostyril	C_9H_9NO	147.13	C_9H_9ON
19 — cinnamic acid	$C_6H_5.CH_2.CH_2COOH$	150.13	$C_9H_{10}O_2$
20 — cœrulignone	$(HO)_2:C_{12}H_4(OCH_3)_4$	306.22	$C_{16}H_{18}O_6$
21 — coumaric acid, *o*	$OH.C_6H_4.(CH_2)_2.COOH$	166.13	$C_9H_{10}O_3$
22 — — —, *p*	,, ,,	166.13	,,
23 — cyanic acid	HCN	27.02	CHN
24 — mellitic acid	$C_6H_6(COOH)_6$	348.16	$C_{12}H_{12}O_{12}$
25 — phenazine, 5 : 10	$C_6H_4:(NH)_2:C_6H_4$	182.16	$C_{12}H_{10}N_2$
26 —phthalic acid,1 :4 :2 :3	$C_6H_6(COOH)_2$	168.10	$C_8H_8O_4$
27 — — —, tere-	,, ,,	168.10	,,
28 — quinone, see	Dihydroxy benzene		
29 — — phthalein	$C_{20}H_{12}O_5$	332.20	$C_{20}H_{12}O_5$
30 Hydroxy acetophenone,*o*	$C_6H_5.CO.CH_2OH$	136.10	$C_8H_8O_2$

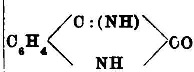
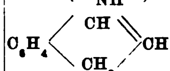
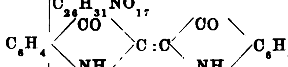
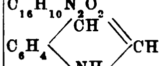
Density $H_2O=1$.	Solubility in — Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
	h.s.	s.		218—220		1
	s.	s.				2
	h.s.	s.	s.	liq.	d.	3
				liq.	264—265	4
	i.	5 : 100/16°	s.	127	d.	5
		h.s.				6
	i.	h.s.s.	s. alk.			7
		s.	s.	156	d.	8
		v.s.		liq.		9
		s.	s.	124	d.	10
0.957/15					176—176.5	11
1.011/45°	s.s.	v.s.		41—42	243—245	12
		s.	s.	61	220—225	13
	i.	h.s.	s.	169	subl.	14
	h.s.	s.	s.	76		15
	i.	s	s.	110		16
	1 :400/15°	h.s.		138		17
	i.	s.	s.	163		18
1.0710/48.7°	1 :168/20°	s.	s.	48.7	279	19
	v.s.s.	h.s.	v.s.s.	190		20
	1 :20/18°	s.	s.	82—83		21
	h.s.	s.	s.	128		22
0.697/18°	m.	m.	m.	- 14	26.11	23
		s.s.		d.		24
						25
	1 :100 c.	s.	s.s.	153		26
	i.					27
						28
	h.v.s.s.	s.		232—234	d.	29
	h.v.s.	v.s.	v.s.		96—97/10	30

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Hydroxy aceto-phenone, *m*	$C_6H_5.CO.CH_2OH$	136.10	$C_8H_8O_2$
2 — — —, *p*	,, ,,	136.10	,,
3 — acrylic acid, β	$CHOH:CH.COOH$	88.05	$C_3H_4O_3$
4 — anthraquinone, 1	$C_6H_4:(CO)_2:C_6H_3OH$	224.13	$C_{14}H_8O_3$
5 — —, 2	,, ,,	224.13	,,
6 — azobenzene, 4	$C_6H_5.N_2.C_6H_4OH$	198.16	$C_{12}H_{10}ON_2$
7 — —, 2	,, ,,	198.16	,,
8 — benzaldehyde, *o*	$HO.C_6H_4.CHO$	122.08	$C_7H_6O_2$
9 — —, *m*	,, ,,	122.08	,,
10 — —, *p*	,, ,,	122.08	,,
11 — benzyl alcohol, *o*	$HO.C_6H_4.CH_2OH$	124.10	$C_7H_8O_2$
12 — — —, *m*	,, ,,	124.10	,,
13 — — —, *p*	,, ,,	124.10	,,
14 — butyric acid, α	$C_2H_5.CHOH.COOH$	104.08	$C_4H_8O_3$
15 — — —, β	$CH_3.CHOH.CH_2.COOH$	104.08	,,
16 — — —, γ	$CH_2OH.(CH_2)_2COOH$	104.08	,,
17 — — —, aceton acid	$(CH_3)_2:COH.COOH$	104.08	,,
18 — caproic acid	$C_5H_{10}(OH).COOH$	132.13	$C_6H_{12}O_3$
19 — — —, diethyl glycollic acid	$(C_2H_5)_2:C(OH)COOH$	132.13	,,
20 — — —, α	$CH_3.(CH_2)_3.CHOH.COOH$	132.13	,,
21 — caprylic acid, α	$CH_3.(CH_2)_5.CHOH.COOH$	160.17	$C_{18}H_{16}O_3$
22 — citric acid	$C_3H_3(OH)_2(COOH)_3.H_2O$	226.11	$C_6H_8O_8$
23 — diphenyl, 4	$C_6H_5.C_6H_4OH$	170.14	$C_{12}H_{10}O$
24 — diphenylamine, 4	$C_6H_5.NH.C_6H_4OH$	185.16	$C_{12}H_{11}ON$
25 — —, 3	,, ,,	185.16	,,
26 — ethyl amine	$CH_2(OH)CH_2.NH_2$	61.08	C_2H_7ON
27 — — piperidine	$C_5H_{10}N.C_2H_4OH$	129.17	$C_7H_{15}ON$
28 — glutaric acid, α	$C_3H_5(OH)(COOH)_2$	148.09	$C_5H_8O_5$
29 — hydroquinone,1:2:4	$C_6H_3(OH)_3$	126.08	$C_6H_6O_3$
30 — isocaprylic acid	$[(CH_3)_2:CH]_2:COH.COOH$	160.17	$C_8H_{16}O_3$
31 — methyl benzoic acid, *o*	$CH_2OH.C_6H_4.COOH$	152.10	$C_8H_8O_3$
32 — methylene acetone	$CHOH:CH.CO.CH_3$	86.07	$C_4H_6O_2$
33 — naphthoquinone, 1:4:5	$C_{10}H_5O_2.OH$	174.10	$C_{10}H_6O_3$
34 — —, 1:4:2	,, ,,	174.10	,,
35 — naphthoic acid, OH:COOH=1:2	$C_{10}H_6OH.COOH$	188.12	$C_{11}H_8O_3$

Density $H_2O=1$.	Solubility in— Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
				95—96		1
				110		2
	s.	s.	s.	liq.		3
	s. alk.	s.	s.	190	subl.	4
	h.s.	v.s.	v.s.	302	subl.	5
	h.v.s.s.	v.s.	v.s.	152		6
				82		7
1.1520/15°	s.	m.	m.	– 21	196.5	8
	h.s.	s.	s.	107	240	9
	c.s.s.	s.	s.	116	subl.	10
1.1613/25°	1 : 15/22°, h.m.	v.s.	v.s.	86	subl.	11
	h.s.	s.	s.	67	300 d.	12
	s.	s.	s.	110		13
				42	225 d.	14
						15
				liq. —17		16
	v.s.	v.s.	v.s.	79	212	17
	v.s.	v.s	v.s.	72.5—73.5	subl.	18
	1 : 2.85/ 17.5°	s.	s.	80	subl. 50	19
				60—62		20
	v.s.s.	v.s.	v.s.	69.5		21
	v.s.	v.s.	v.s.	159—160		22
	h.s.	s.	s., s. $CHCl_3$	160—162	305—308	23
	c.v.s.s.	s.	s.	70	330	24
	h.s.s.	s.	s.	81.5—82	340	25
				59—60		26
	m.	s.		liq.	199	27
	s.	s.		72—73		28
	v.s.	v.s.	v.s.	140.5		29
	s.s.	s.	s.	110—111		30
	1 : 43/20°	s.	s.	120		31
						32
	i., s. $CHCl_3$	s., s. acetic.	s.s.	151—154		33
	h.s.s.	s.	s.	d. 190	subl.	34
	h.s.s.	s.	s.	186		35

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Hydroxy naphthoic acid, *isom.*	$C_{10}H_6OH.COOH$	188.12	$C_{11}H_8O_3$
2 ———, 8:1	" "	188.12	"
3 ———, *isom.*	" "	188.12	"
4 ———, *isom.*	" "	188.12	"
5 ———, *isom.*	" "	188.12	"
6 ———, 2:1	" "	188.12	"
7 ———, 3:2	" "	188.12	"
8 — nicotinic acid, *p*	$C_5H_3N(OH)COOH$	139.08	$C_6H_5O_3N$
9 — phenyl acetic acid, *o*	$HO.C_6H_4.CH_2.COOH$	152.10	$C_8H_8O_3$
10 ———, *m*	" "	152.10	"
11 ———, *p*	" "	152.10	"
12 —— ethylamine, *p*	$OH.C_6H_4.C_2H_4.NH_2$	137.14	$C_8H_{11}ON$
13 —— propiolic acid, *p*	$OH.C_6H_4.C:C.COOH$	162.09	$C_9H_6O_3$
— phthalic acid, COOH : COOH : OH=			
14 1 : 2 : 3	$C_6H_3(OH)(COOH)_2$	182.09	$C_8H_6O_5$
15 1 : 2 : 4	" "	182.09	"
16 1 : 3 : 2	" " $.H_2O$	200.11	"
17 1 : 3 : 4	" "	182.09	"
18 1 : 3 : 5	" "	182.09	"
19 1 : 4 : 3	" "	182.09	"
20 — pyridine, α pyridone		95.08	C_5H_5ON
21 ——, β pyridone		95.08	"
22 ——, γ pyridone		113.10	"
23 — quinaldine, 8 : 2	$C_{10}H_9NO$	159.13	$C_{10}H_9ON$
24 ——, 6 : 2	"	159.13	"
25 ——, 5 : 2	"	159.13	"
26 ——, 4 : 2	" $.2H_2O$	195.16	"
27 — quinoline, 8 : 2	C_9H_7NO	145.11	C_9H_7ON

Density $H_2O=1$.	Solubility in Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
	h.s.	v.s.		234—237	subl.	1
	s.	v s.	v.s.	169		2
	h.s.	s.		245—247 d.		3
	h.s.	v.s		187		4
	h.s.			210—211		5
	v.s.s.	v.s. (abs.)		156 d.		6
	c.s.s.	s.	s.	216		7
	h.s.s	v.s.s.	v.s.s	d. 301—302	subl.	8
	s.		s.	137		9
	v.s.	v.s.	v.s	128.5		10
	h.v.s.	v.s.	v.s.	145		11
	c.s.s.	1 : 10 h.	s. C_6H_6	161—163	175—181 /8mm.	12
	h.s.	s.		192—193	d.	13
	1 : 5/17°	v.s.	v.s.	150		14
	1 : 32/10°	s.	s.	181		15
	1 : 40/100°	s.	s.	239, an. 243—244		16
	c.v.s.s.	v.s.	s.	305—306		17
	1 : 5.4/100°	s.	s.	288		18
	h.s.s.	s.	s	subl.		19
	v.s.	v.s.	s.	106—107	280—281	20
	s.	s.		129		21
	1 : 1/15°	s.	v.s.s.	66, an. 148.5		22
	s.s.	h.s.	s.	74	266—267 subl.	23
	v.s.s.	s.	s.	213		24
	i.	h.s.	s	232—234		25
	1 : 100 c.	s.	i.	231		26
	0.48 : 100 /15°	s.	s.s.	75.8	266.6/ 752mm.	27

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Hydroxy quinoline,7 : 2	C_9H_7NO	145.11	C_9H_7ON
2 — —, 6 : 2	,,	145.11	,,
3 — —, carbostyril	,,	145.11	,,
4 — salicylic acid, see	Dihydroxy benzoic acid		
5 — stearic acid, *a*	$C_{18}H_{36}O_3$	300.38	$C_{18}H_{36}O_3$
6 — — —, *β*	,,	300.38	,,
— toluic acid, COOH : CH_3 : OH =			
7 2 : 1 : 3	$CH_3.C_6H_3(OH)COOH$	152.10	$C_8H_8O_3$
8 2 : 1 : 6	,, ,,	152.10	,,
9 2 : 1 : 4	,, ,,	152.10	,,
10 2 : 1 : 5	,, ,, $.\frac{1}{2}H_2O$	161.11	,,
11 3 : 1 : 2	,, ,,	152.10	,,
12 3 : 1 : 4	,, ,,	152.10	,,
13 3 : 1 : 5	,, ,,	152.10	,,
14 3 : 1 : 6	,, ,, $.\frac{1}{2}H_2O$	161.11	,,
15 4 : 1 : 2	,, ,,	152.10	,,
16 4 : 1 : 3	,, ,,	152.10	,,
17 Hypogæic acid, physetoleic acid	$C_{15}H_{29}COOH$	254.32	$C_{16}H_{30}O_2$
18 Hypoxanthine	$C_5H_4N_4O$	136.10	$C_5H_4ON_4$
19 Hystazarin, 2 : 3 dihydroxy anthra quinone	$C_6H_4:(CO)_2:C_6H_2:(OH)_2$	240.13	$C_{14}H_8O_4$
20 Iuesatine		146.11	$C_8H_6ON_2$
21 Indene		116.11	C_9H_8
22 Indican	$C_{26}H_{31}NO_{17}$	629.39	$C_{26}H_{31}O_{17}N$
23 Indigotin		262.18	$C_{16}H_{10}O_2N_2$
24 Indin	$C_{16}H_{10}N_2O_2$	262.18	,,
25 Indole		117.11	C_8H_7N
26 Indophenine	$C_{12}H_7ONS$	213.19	$C_{12}H_7ONS$

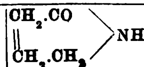
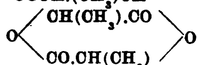
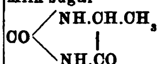
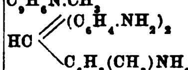
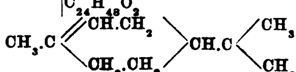
Density $H_2O=1$.	Solubility in Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
			s.s.	199—200 d.		1
	h.s.	s.s.	v.s.s.	193—195	>360	2
	h.s.	v.s.	v.s.	199—200	subl.	3
						4
		0.58 : 100 /20°	s.	75		5
				81—81.5		6
	h.s.	v.s.	v.s.	168		7
	h.s.	v.s.	v.s.	183		8
	c.s.	v.s.	v.s.	172		9
	h.s.	v.s.	v.s.	177—178		10
			s. $CHCl_3$	163—164		11
	h.s.	v.s.	v.s.	150		12
	c.s.			208	subl.	13
	h.s.	s.	s.	172—173		14
	h.s.	s.	s.	206—207		15
	i.	h.s.	s.	177		16
	i.	s.	s.	33		17
	1 :300 c h.s.	s.s.	i.		d.	18
		h.s.s.	s.s.	> 280		19
	i.	h.s.	s.s.			20
1.0059/4°				- 2	181.3	21
	s.	s		syrup.	d.	22
1.35	i.	i.	s. aniline.	156—158 /0mm.		23
	i.	h.s.s.	s.s.			24
	h.s.	s.	s.	52	253—254	25
	i.	v.s.s.	v.s.s.			26

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Indoxyl	$C_6H_4\left\langle{C(OH) \atop NH}\right\rangle CH$	133.11	C_8H_7ON
2 Indoxylic acid	$C_9H_7NO_3$	177.11	$C_9H_7O_3N$
3 Indoxyl sulphuric acid	$C_8H_7NSO_4$	213.17	$C_8H_7O_4NS$
4 Inosite, see	Dambose		
5 Inulin	$C_{36}H_{62}O_{31}$	990.68	$C_{36}H_{62}O_{31}$
6 Iodo-aniline, *m*	$C_6H_4I.NH_2$	219.01	C_6H_6NI
7 — —, *p*	„	219.01	„
8 — benzene	C_6H_5I	203.99	C_6H_5I
9 — propionic acid, *α*	$CH_3.CHI.COOH$	199.98	$C_3H_5O_2I$
10 — — — —, *β*	$CH_2I.CH_2COOH$	199.98	„
11 Iodoform	CHI_3	393.77	CHI_3
12 Iodoso benzene	C_6H_5IO	219.99	C_6H_5OI
13 Iodoxy benzene	$C_6H_5IO_2$	235.99	$C_6H_5O_2I$
14 Ionone	$C_{13}H_{20}O$	192.23	$C_{13}H_{20}O$
15 — semicarbozone, *α*	$C_{13}H_{20}:N.NH.CO.NH_2$	249.28	$C_{14}H_{23}ON_3$
16 — —, *β*	„ „	249.28	„
17 Irone	$C_{13}H_{20}O$	192.23	$C_{13}H_{20}O$
18 Isatin	$C_6H_4\left\langle{CO \atop N}\right\rangle COH$	147.09	$C_8H_5O_2N$
19 — anilide, *α*	$C_6H_4\left\langle{CO \atop NH}\right\rangle C:N.C_6H_5$	222.17	$C_{14}H_{10}ON_2$
20 — chloride	$C_6H_4:CO(N):C.Cl$	165.54	C_8H_4ONCl
21 Isatinic acid	$NH_2.C_6H_4.CO.COOH$	165.11	$C_8H_7O_3N$
22 Isatoic anhydride	$C_6H_4\left\langle{CO.O \atop NH.CO}\right.$	163.09	$C_8H_5O_3N$
23 Isatoxime	$C_6H_4\left\langle{C:NOH \atop N:C.OH}\right.$	162.11	$C_8H_6O_2N_2$
24 Isatropic acid	$C_9H_8O_2$	148.11	$C_9H_8O_2$
25 Isethionic acid	$C_2H_4(OH)SO_3H$	126.12	$C_2H_6O_4S$
26 Iso-anthraflavic acid, 2 : 7	$C_6H_4:(CO)_2:C_6H_2(OH)_2.H_2O$	258.15	$C_{14}H_8O_4$

Density $H_2O=1$.	Solubility in Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
			s. alk.	85		1
	s.s.				122—123 subl. d.	2
	s.	h.s.	i.	d.		3
						4
1.3491	s.s.	s.s.		d. 160		5
	i.	s.		27		6
	i.	s.		64		7
1.833/15°	i.	s.		- 28.5	188.2	8
	v.s.s.			44.5—45.5		9
	h.s.	v.s.	v.s.	85		10
4.008/17°	i.	s.	s.	119	subl. d.	11
	h.s.	s.	i.	105—106 d.		12
	h.s.			167		13
0.935/20°		s.	s., s. C_6H_6		126—128 /12mm.	14
		v.s.s.ligroin		117—118		15
				148—149		16
0.939/20°	v.s.s.	s.	s.	liq.	144/16mm.	17
	h.s.	s.	s.	200—201	subl.	18
		h.s.	s.	126		19
	i.	s.	s. to B.	d. 180		20
	s.s.			d.		21
		s s.	s.s.	d. 230		22
	v.s.s.	s.		202		23
	h.v.s.s.	s.s.	i.	237—237.5		24
	v.s.			syrup.		25
	s. alk.	s.	v.s.s.	an. > 330	subl.	26

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Iso-cholesterin	$C_{26}H_{43}OH$	372.48	$C_{26}H_{44}O$
2 — — benzoate	$C_{26}H_{43}O.C_7H_5O$	476.55	$C_{32}H_{48}O_2$
3 — cinchomeronic acid	$C_7H_5NO_4.H_2O$	185.11	$C_7H_5O_4N$
4 — citric acid	$C_6H_8O_7$	192.09	$C_6H_8O_7$
5 — coumarin	$C_6H_4\left\langle\begin{array}{l}CH:CH\\ \quad\vert\\ CO.O\end{array}\right.$	146.09	$C_9H_6O_2$
6 — crotonic acid	$CH_3:CH.CH_2.COOH$	86.07	$C_4H_6O_2$
7 — cymene	$C_{10}H_{14}$	134.16	$C_{10}H_{14}$
8 — dulcitol, rhamnose	$CH_3.(CHOH)_4.CHO.H_2O$	182.14	$C_6H_{12}O_5$
9 — durene, 1 : 2 : 3 : 5	$C_6H_2(CH_3)_4$	134.16	$C_{10}H_{14}$
10 — eugenol, 4 : 3 : 1	$C_6H_3(OH)(OCH_3)CH:CH.CH_3$	164.15	$C_{10}H_{12}O_2$
11 — ferulic acid	$C_7H_7O_2.C_2H_2.COOH$	194.13	$C_{10}H_{10}O_4$
12 — glucosamine	$C_6H_{11}O_5(NH_2)$	179.14	$C_6H_{13}O_5N$
13 — hydrobenzoin	$C_6H_5.CHOH.CHOH.C_6H_5$	214.18	$C_{14}H_{14}O_2$
14 — naphthazarin, 2 : 3	$C_{10}H_4O_2(OH)_2$	190.10	$C_{10}H_6O_4$
15 — nitroso acetone	$CH_3.CO.CH:N.OH$	87.09	$C_3H_5O_2N$
16 — orcinol, see	Dihydroxy toluene		
17 — phloretinic acid	$C_9H_{10}O_3$	166.13	$C_9H_{10}O_3$
18 — quinoline	C_9H_7N	129.11	C_9H_7N
19 — vanillin, 1 : 4 : 3	$C_6H_3(CHO)(OCH_3)OH$	152.10	$C_8H_8O_3$
20 Isoprene	C_5H_8	68.09	C_5H_8
21 Itaconic acid	$CH_2:C(COOH)CH_2.COOH$	130.07	$C_5H_6O_4$
22 Itamalic acid	$CH_2OH.CH(COOH)CH_2.COOH$	148.09	$C_5H_8O_5$
23 Juglon, see	Hydroxy naphthoquinone		
24 Kairoline, N. methyl tetra hydroquinoline	$C_9H_{10}N.CH_3$	147.16	$C_{10}H_{13}N$
25 Ketazine	$(CH_3)_2:C:N_2:C:(CH_3)_2$	112.15	$C_6H_{12}N_2$
26 Keto-butyric acid, propionylformic acid	$CH_3.CH_2.CO.COOH$	102.07	$C_4H_6O_3$
27 — *cyclo*-heptane, suberone	$CO\left\langle\begin{array}{l}CH_2.CH_2.CH_2\\ \qquad\qquad\quad\vert\\ CH_2.CH_2.CH_2\end{array}\right.$	112.13	$C_7H_{12}O$
28 — *cyclo*-pentane, adipinketone	$CO\left\langle\begin{array}{l}CH_2.CH_2\\ \qquad\quad\vert\\ CH_2.CH_2\end{array}\right.$	84.09	C_5H_8O

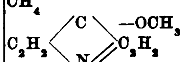
Density $H_2O=1$.	Solubility in— Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
		s.s.	s.	137—138		1
		s.	s.	190—191		2
	v.s.s.	v.s.s.	v.s.s.	236	subl. d.	3
	s.					4
	i.	v.s.	s., s. C_6H_6	47	285—286 /219mm.	5
1.018/0°	1 :35/19°			155	171.9	6
0.862/20°				– 20 liq.	171—172	7
1.4708/20°	57.11 : 100/19°	54 : 10°		92—93		8
		s.	s.		195	9
1.08/16°	v.s.s.	s.	s.		258—262	10
	h.s.	s.	s.	228		11
		s.	i.			12
	s.s.	v.s.	v.s.	121		13
	h.s.s.	s.	s.	276		14
	v.s.		v.s.	65	subl.	15
						16
	s.			128—129		17
1.1025/20°		s.		24.6	240/730mm.	18
1.196	h.s.	s.	s.	116	179/15mm.	19
0.6867/16.5°					34.0/762mm.	20
1.573-1.632	1 :17/10°	1 : 4 (88%)	s.	161	d.	21
	del.	s.	s.	64	d.	22
						23
1.022/20°		v.s.	s.s.		242—244 /720mm.	24
0.836	s.			31.5—32	131	25
1.2/17°					74—78/ 25mm.	26
					179—181	27
					130—130.5	28

Name.	Formula	Formula Weight.	Empirical Formula.
1 Keto pyrrolidine		85.09	C_4H_7ON
2 Kynuric acid, 1 : 2	$C_6H_4(COOH).NH.CO.COOH$	209.11	$C_9H_7O_5N$
3 Lactamide	$CH_3.CHOH.CONH_2$	89.09	$C_3H_7O_2N$
4 Lactic acid, *d.*, *l.*	$CH_3CHOH.COOH$	90.06	$C_3H_6O_3$
5 — —, para, *d.*	„ „	90.06	„
6 Lactate, ethyl	$CH_3CHOH.COOC_2H_5$	118.11	$C_5H_{10}O_3$
7 Lactic anhydride, *a*	$CH_3.CHOH.COO$ $COOH.(CH_3)CH$	162.11	$C_6H_{10}O_5$
8 Lactide, *i*		144.09	$C_6H_8O_4$
9 Lactobionic acid	$C_{12}H_{22}O_{12}$	358.24	$C_{12}H_{22}O_{12}$
10 Lactose, see	Milk sugar		
11 Lactyl urea		132.11	$C_4H_6O_2N_2$
12 Lævulin	$(C_6H_{10}O_5)x$	(162.11)	
13 Lævulinic acid	$CH_3CO.CH_2CH_2.COOH$	144.09	$C_5H_8O_3$
14 Lævulose, fructose	$C_6H_{12}O_6$	196.13	$C_6H_{12}O_6$
15 Lauric acid	$C_{11}H_{23}COOH$	200.25	$C_{12}H_{24}O_2$
16 Lead tetraethyl	$Pb(C_2H_5)_4$	324.40	$C_8H_{20}Pb$
17 — tetramethyl	$Pb(CH_3)_4$	267.32	$C_4H_{12}Pb$
18 — triethyl	$Pb(C_2H_5)_3$	294.35	$C_6H_{15}Pb$
19 Lecithin	$C_{42}H_{84}NPO_9$	777.93	$C_{42}H_{84}O_9NP$
20 Lepidine, 1 : 3	$C_9H_6N.CH_3$	143.13	$C_{10}H_9N$
21 Leucaniline		303.30	$C_{20}H_{21}N_3$
22 Leucaurine	$CH(C_6H_4OH)_3$	292.22	$C_{19}H_{16}O_3$
23 Leucinic acid	$C_5H_{10}(OH)COOH$	132.13	$C_6H_{12}O_3$
24 Leuconic acid	$C_5H_8O_9$	212.09	$C_5H_8O_9$
25 Lichenine	$(C_6H_{10}O_5)x$	(162.11)	
26 Lignoceric acid	$C_{24}H_{48}O_2$	368.50	$C_{24}H_{48}O_2$
27 Limonine, *d.*		136.18	$C_{10}H_{16}$
28 — *r*	„ „	136.18	..

Density $H_2O=1$.	Solubility in Water.	Solubility in Alcohol.	Solubility in Ether.	M.P. °C.	B.P. °C.	
				24.6	245	1
	v.s.s.	h.s.	s.s.	257		2
	v.s.	s.		74		3
1.2485/15°	del.	m.	s.	18	119/12mm.	4
	m.	m.	s.	25—26	d.	5
1.055/0				liq.	154.5	6
	s.s.	s.	s.	d. 250—260		7
	s.s.	c.v.s.s.		125	255	8
	v.s.	s.s.	i.	100 : lactone		9
						10
	s.	s.	s.s.	145		11
	s.	v.s.s. (abs.)	i.	d.		12
1.1395/20°	m.	s.	s.	32.5—33	250—253	13
	s.	s.	s.	95	d. 100	14
0.883/20°	i.	s.	s.	43.6	225/100	15
1.62	i.			liq.	152	16
2.034/0°				liq.	110	17
1.471/10°	i.			liq.	d.	18
	i.	s.	s.	d.		19
1.0862/20°	s.s.	m.	m.	liq.	265.5/746.7	20
	h.s.s.	v.s.	s.s.	100		21
	s.s.	s.	s. acetic.			22
	s.	s.	s.	76—77 rac., 81—82 act.		23
	v.s.	s.s.	v.s.s.			24
	h.s.	i.	i.			25
	s. CS_2, C_6H_6	s.	s.	80—81		26
0.853/10°			s. $CHCl_3$		177.6—178	27
0.846/20°		s.	s. $CHCl_3$		175—176	28

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Linalool	$(CH_3)_2:C:CH.(CH_2)_2.C(CH_3).OH.CH:CH_2$	154.19	$C_{10}H_{18}O$
2 Linoleic acid	$C_{18}H_{32}O_2$	280.35	$C_{18}H_{32}O_2$
3 Lophine	$C_{21}H_{16}N_2$	298.27	$C_{21}H_{16}N_2$
4 Luteolin	$(OH)_2C_6H_2 < \begin{matrix} O.C.C_6H_3(OH)_2 \\ \Vert \\ CO.CH \end{matrix}$	286.16	$C_{15}H_{10}O_6$
5 Lutidine, 2 : 6	$C_5H_3N(CH_3)_2$	107.12	C_7H_9N
6 Lutidine acid, see	Pyridine dicarboxylic acid		
7 Lysine, see	Amino caproic acid		
8 Maclurin	$CO < \begin{matrix} C_6H_2(OH)_3 \\ C_6H_3(OH)_2 \end{matrix}$	280.17	$C_{13}H_{10}O_6$
9 Maleïc acid	$C_2H_2(COOH)_2$	116.05	$C_4H_4O_4$
10 Malic acid, *l*	$COOH.CHOH.CH_2.COOH$	134.07	$C_4H_6O_5$
11 Malic amide	$C_2H_3(OH)(CO.NH_2)_2$	132.10	$C_4H_8O_3N_2$
12 Malate, ethyl	$\begin{matrix} CH_2.COOC_2H_5 \\ \\ CHOH.COOC_2H_5 \end{matrix}$	190.15	$C_8H_{14}O_5$
13 Malonic acid	$CH_2(COOH)_2$	104.05	$C_3H_4O_4$
14 Malonyl urea	$CO:(NH.CO)_2:CH_2$	128.09	$C_4H_4O_3N_2$
15 Maltose	$C_{12}H_{22}O_{11}.H_2O$	360.26	$C_{12}H_{22}O_{11}$
16 Mandelic acid	$C_6H_5.CHOH.COOH$	152.10	$C_8H_8O_3$
17 Mannitan, amorph	$C_6H_{12}O_5$	164.13	$C_6H_{12}O_5$
18 ——, cryst	,,	164.13	,,
19 Mannitol, *d*	$C_6H_8(OH)_6$	182.14	$C_6H_{14}O_6$
20 — nitrate	$C_6H_8(ONO_2)_6$	452.15	$C_6H_8O_{18}N_6$
21 Manno-heptose *d*	$C_6H_7(OH)_6CHO$	210.15	$C_7H_{14}O_7$
22 — octite, *d*	$C_8H_{18}O_8$	242.18	$C_8H_{18}O_8$
23 Mannonic acid, *d, l, i.*	$C_5H_6(OH)_5COOH$	196.13	$C_6H_{12}O_7$
24 —— lactone, *d*	$C_6H_{10}O_6$	178.11	$C_6H_{10}O_6$
25 Margaric acid	$C_{16}H_{33}COOH$	270.36	$C_{17}H_{34}O_2$
26 Meconic acid	$C_7H_4O_7.3H_2O$	254.12	$C_7H_4O_7$
27 Meconine	$C_{10}H_{10}O_4$	194.13	$C_{10}H_{10}O_4$
28 Melam	$C_6H_9N_{11}$	235.21	$C_6H_9N_{11}$
29 Melene	$C_{30}H_{60}$	420.63	$C_{30}H_{60}$
30 Melilotic acid	$C_6H_4(OH)CH_2.CH_2.COOH$	166.13	$C_9H_{10}O_3$
31 Melissic acid	$C_{29}H_{59}COOH$	452.63	$C_{30}H_{60}O_2$
32 Melissyl alcohol	$C_{30}H_{61}OH$	438.65	$C_{30}H_{62}O$
33 Mellitic acid	$C_6(COOH)_6$	342.11	$C_{12}H_6O_{12}$

Density $H_2O=1$.	Solubility in— Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
0.870/15°				liq.	199—200	1
0.9206/14°				oil.		2
	i.	s s.	s.s.	270		3
	v.s.s	1 : 37	s.s.	328—329.5		4
0.946/0°	1 : 3.5			liq.	142—143	5
						6
						7
	h.s.	s.	s.	200		8
1.590	1 : 2/10°	s.	s.	130—130.5	d.	9
1.559/4°	v.s.	v.s.		100	d.	10
	1 : 12/8°	i.		170		11
1.1210/21°				liq	149—25mm.	12
	v.s.	s.	s.	132	d.	13
	h.s.			d.		14
1.540/17.5°	s.	s.s.				15
1.36/4°	15.97 : 100/20°	s.	s.	inact. 118.5, *l*. 133		16
	s.	v.s. (abs.)	i.	100		17
	1 : 4/15°	s.s.				18
1.521	27 : 100/25°	h.s.	i.	165	278/1mm.	19
1.604	i.	h.s.	s.	108	expl.	20
	s.	s.s.		134—135		21
	h.s.s.			258		22
	s.			FORMS LACTONE		23
				149—153		24
				59.5	227/100	25
	s.	s.	s.			26
	1 : 22/100°			102	subl.	27
	i.	s.h. KOH				28
0.89		3.6 : 100 h		62		29
	1 : 20/18°	s.	s.	82—83	d.	30
		h.s.	s.s.	90		31
				88		32
	v.s.	s.		286—288 under press.		33

Name.	Formula.	Formula Weight.	Empirical Formula.
1 **Mellophanic acid**	$C_6H_2(COOH)_4$ (1:2:3:5)	254.10	$C_{10}H_6O_8$
2 **Menthene**	$C_{10}H_{18}$	138.19	$C_{10}H_{18}$
3 **Menthol, *d***	$C_{10}H_{19}(OH)$	156.20	$C_{10}H_{20}O$
4 **Menthone, *d***	$C_{10}H_{18}O$	154.19	$C_{10}H_{18}O$
5 **Mercury di-ethyl**	$Hg(C_2H_5)_2$	258.70	$C_4H_{10}Hg$
6 — **dimethyl**	$Hg(CH_3)_2$	230.66	C_2H_6Hg
7 — **dinaphthyl, 1**	$Hg(C_{10}H_7)_2$	454.81	$C_{20}H_{14}Hg$
8 — —, **2**	,,	454.81	,,
9 — **diphenyl**	$H_2(C_6H_5)_2$	354.74	$C_{12}H_{10}Hg$
10 — **mercaptan**	$Hg_2(C_2H_5)_2S$	491.36	$C_4H_{10}SHg_2$
11 **Mesaconic acid**	$(CH_3)(COOH)C:CH.COOH$	130.07	$C_5H_6O_4$
12 **Mesidine, 1 : 3 : 5 : 2**	$C_6H_2(CH_3)_3NH_2$	135.16	$C_9H_{13}N$
13 **Mesitol**	$C_6H_2(CH_3)_3OH$	136.14	$C_9H_{12}O$
14 **Mesitylene**	$C_6H_3(CH_3)_3$	120.14	C_9H_{12}
15 **Mesitylenic acid**	$C_6H_3(CH_3)_2COOH$	150.13	$C_9H_{10}O_2$
16 **Mesityl oxide**	$(CH_3)_2:C:CH.COCH_3$	98.11	$C_6H_{10}O$
17 **Mesorcin**	$C_6H(CH_3)_3(OH)_2$	152.14	$C_9H_{12}O_2$
18 **Mesoxalic acid**	$(COOH)_2C(OH)_2$	136.05	$C_3H_4O_6$
19 **Metacetone**	$C_6H_{10}O$	98.11	$C_6H_{10}O$
20 **Metacroleïn**	$C_9H_{12}O$	136.14	$C_9H_{12}O$
21 **Metaldehyde**	$(CH_3.CHO)_3$	132.12	$C_6H_{12}O_3$
22 **Metanilic acid**	$C_6H_4(NH_2)SO_3H.\frac{1}{2}H_2O$	182.17	$C_6H_7O_3NS$
23 **Metastyroline**	$(C_8H_8)x$	(104.10)	
24 **Methacrylic acid**	$CH_2:C:(CH_3)COOH$	86.07	$C_4H_6O_2$
25 **Methane**	CH_4	16.04	CH_4
26 **Methoxy pyridine, γ**		109.10	C_6H_7ON
27 — **quinoline, γ**	$C_9H_6N(OCH_3)$	159.13	$C_{10}H_9ON$
28 **Methyl acetanilide**	$C_6H_5.N(CH_3).CO.CH_3$	149.14	$C_9H_{11}ON$
29 — **acridine, 1**		193.17	$C_{14}H_{11}N$
30 — —, **3**	$C_{13}H_8N.CH_3$	193.17	,,
31 — —, **5**	,, ,,	193.17	,,
32 — **alcohol**	CH_3OH	32.04	CH_4O
33 — **alizarin**	$C_6H_4:(CO)_2:C_6H(CH_3)(OH)_2$	254.16	$C_{15}H_{10}O_4$
34 — **amine**	$CH_3.NH_2$	31.06	CH_5N
35 — **amino acetic acid**	$CH_2(NH.CH_3)COOH$	89.08	$C_3H_7O_2N$

Density $H_2O=1$.	Solubility in Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
	s.			238		1
0.897/0°				167.4		2
0.890/15°	s.s.	s.	s.	42	212	3
0.9126/0°	m. $CHCl_3$	m.	m. C_6H_6	liq.	206-208	4
2.44	i.	s.s.	s.	liq.	159	5
3.069	i.			liq.	96	6
1.929	s. CS_2	h.s.s	s. $CHCl_3$	243		7
				238		8
2.32	s. CS_2	h.s.s	s. $CHCl_3$, C_6H_6	120	300 d	9
				82	d.	10
	2.7 : 100/18°	s.		202	d.	11
0.9633				liq.	227	12
		s.	s.	68—69	219.5	13
0.8694/10°	i.	s.	s.	– 57.5	164.5	14
	h.s.s.	v.s.		165—166	subl.	15
0.8578/20°	i.	m.		liq.	131—132	16
	c.s.s.	v.s.	v.s.	149—150	275	17
	s.	s.	s.	115		18
$>H_2O$	i.				84	19
	h.v.s.s.	s.	s.	50	170	20
	i.	s.s.	s.s.	246.2		21
	1 : 68/15°					22
1.054/13°	i.	i.	v.s.s.		320 d.	23
1.0153/20°	v.s.			16	160.5	24
	0.054 : 1 vol.			–184	–164	25
	s.			liq.	191—738mm.	26
1.665/0°		s.		31	241	27
	i.	s.		101	237	28
	s. C_6H_6	v.s.	v.s.	88		29
				125—126		30
				114		31
0.8102/0°	m.	m.	m.	– 97.8	64.7	32
	s. acetone	s.	s.	232—233	subl. 200	33
0.699/—11°	1150 : 1 vol.	s.		gas.	–6.7/75mm.	34
	v.s.	s.s.		130	250 d.	35

Name	Formula	Formula Weight.	Empirical Formula.
1 Methyl aniline	$C_6H_5.NH.CH_3$	107.12	C_7H_9N
2 — anthracene, 1	$C_6H_4:(CH)_2:C_6H_3.CH_3$	192.17	$C_{15}H_{12}$
3 — —, 2	„ „	192.17	„
4 — anthraquinone, 1	$C_{14}H_7O_2.CH_3$	222.16	$C_{15}H_{10}O_2$
5 — —, 2	„ „	222.16	„
6 — arsenic acid	$CH_3.HAsO_2(OH)$	140.01	CH_5O_3As
7 — — oxide	$AsO.CH_3$	105.99	CH_3OAs
8 — — dichloride	$AsCl_2.CH_3$	160.91	CH_3Cl_2As
9 — bromide	CH_3Br	94.95	CH_3Br
10 — carbylamine	$CH_3.NC$	41.04	C_2H_3N
11 — chloride	CH_3Cl	50.49	CH_3Cl
12 — chloroform	$CCl_3.CH_3$	133.41	$C_2H_3Cl_3$
13 — coumarin, *a*	$C_6H_4\left\langle\begin{matrix}C(CH_3):CH\\ \vert\\ O\text{—}CO\end{matrix}\right.$	160.11	$C_{10}H_8O_2$
14 — —, *β*	$C_9H_5O_2.CH_3$	160.11	„
15 — cyanate	$N\ \vdots\ C.OCH_3$	57.04	C_2H_3ON
16 — —, iso	$CO:N.CH_3$	57.04	„
17 — cyanide	CH_3CN	41.04	C_2H_3N
18 — diphenylamine	$(C_6H_5)_2:N.CH_3$	183.18	$C_{13}H_{13}N$
19 — ether	$CH_3.O.CH_3$	46.06	C_2H_6O
20 — furfurane, sylvan	$C_4H_3O.CH_3$	82.07	C_5H_6O
21 — furfurol, 5:2	$C_5H_3O_2.CH_3$	110.08	$C_6H_6O_2$
22 — glycocyamide, see	Creatine		
23 — glycocyamidine, see	Creatinine		
24 — glyoxalin	$C_3H_3N_2.CH_3$	82.09	$C_4H_6N_2$
25 — guaiacol	$C_6H_3(OH)(OCH_3)CH_3$	138.12	$C_8H_{10}O_2$
26 — hydantoin, 1:2:4	$C_4H_6N_2O_2$	114.09	$C_4H_6O_2N_2$
27 — hyrazine	$CH_3.NH.NH_2$	46.07	CH_6N_2
28 — hydroxylamine, *β*	$CH_3.NH.OH$	47.06	CH_5ON
29 — iodide	CH_3I	141.05	CH_3I
30 — isatin	$C_8H_4O_2N(CH_3)$	161.11	$C_9H_7O_2N$
31 — —, pseudo	„ „	161.11	„
32 —mercaptan	$CH_3.SH$	48.10	CH_4S
33 — naphthalene, 1	$C_{10}H_7.CH_3$	142.14	$C_{11}H_{10}$
34 — —, 2	„ „	142.14	„
35 — naphthylamine, 1	$C_{10}H_7.NH.CH_3$	157.15	$C_{11}H_{11}N$

Density $H_2O=1$.	Solubility in Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
0.9863/20°				– 80	193.8	1
	s. CS_2	s.	s. C_6H_6	85—86		2
				199—200		3
		s.	s.	161—163	subl.	4
				177		5
	s.	s.		161		6
				95	d.	7
				liq.	133	8
1.732/0°	s.s.	s.			4.5	9
0.7557	1 : 10	35 : 1		– 45	59.6	10
0.9915/—24°	s.s.	s.	s. acetic.	– 103.6	– 24.1	11
1.3657					74	12
		s.	s. C_6H_6	90		13
				81—82		14
	h.s.	s.				15
	i.	s.			45	16
0.8052/0°	m.	s.	s.	– 44.4	81.6	17
1.0476/2/°	s.			liq.	282	18
	37 : 1 vol.	s.	600 : 1 H_2SO_4	– 138.4	– 23.7	19
0.887					63—63.5	20
1.1087/18°	1 : 30	s.			184—186	21
						22
						23
1.036/10°	s.			– 6	197—199	24
1.1534/0°	1 : 60/15° by vol.	m.	m.	liq.	219	25
	s.	s.		156	subl.	26
		m.	m.		87/745mm.	27
	v.s.	v.s.		42	62.5/15mm.	28
2.2852/15°	1 : 125/ 15° by vol.	s.		– 64.4	42.3	29
	c.s.s.	s. alk.	s. h. HCl	184		30
	s.s.			134		31
$<H_2O$	d.	s.	s.	liq.	5.8/752mm.	32
1.0287/12°		s	s.	liq.	240—242	33
		s		32.5	243—245	34
	s. CS_2	s.	s.		290—293	35

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Methyl naphthyl ether, *a*	$C_{10}H_7.O.CH_3$	158.14	$C_{11}H_{10}O$
2 ———, *β*	,, ,,	158.14	,,
3 — nitrate	$CH_3.NO_3$	77.04	CH_3O_3N
4 — nitrite	CH_3NO_2	61.04	CH_3O_2N
5 — nitrolic acid	$CH(NO_2)NOH$	90.04	$CH_2O_3N_2$
6 — nonyl ketone	$CH_3.CO.C_9H_{19}$	170.23	$C_{11}H_{22}O$
7 — phenazine	$C_6H_4:N_2:C_6H_3.CH_3$	194.17	$C_{13}H_{10}N_2$
8 — phosphine	$CH_3.PH_2$	48.09	CH_5P
9 — phosphoric acid	$CH_3.PO_2(OH)_2$	112.09	CH_5O_4P
10 — piperidine, see	Pipecoline		
11 — propyl benzene, *o*	$CH_3.C_6H_4.C_3H_7$	134.16	$C_{10}H_{14}$
12 ——— *m*	,, ,,	134.16	,,
13 ——, *p*	,, ,,	134.16	,,
14 — *iso* propyl benzine, *m*	$CH_3.C_6H_4.CH:(CH_3)_2$	134.16	,,
15 ———, *p*	,, ,,	134.16	,,
16 — pyrogallol, 1:3:4:5	$C_6H_2(CH_3)(OH)_3$	140.10	$C_7H_8O_3$
17 — pyrrole, 2	$C_4H_3(CH_3)NH$	81.09	C_5H_7N
18 ——, 3	,, ,,	81.09	,,
19 — sulphide	$(CH_3)_2S$	62.12	C_2H_6S
20 — sulphonic acid	$CH_3.SO_3H$	96.10	CH_4O_3S
21 — sulphuric acid	$CH_3.O.SO_2.OH$	112.10	CH_4O_4S
22 —tetra hydro quinoline,	see Kairoline		
23 — thiocarbamide	$CS(NH_2)(NH.CH_3)$	90.14	$C_2H_6N_2S$
24 — thiocyanate, *iso*	$CH_3.NCS$	73.10	C_2H_3NS
25 — uracil	NH——C.CH$_3$ CO < ‖ NH.CO.CH	126.09	$C_5H_6O_2N_2$
26 —urea	$NH_2.CO.NH.CH_3$	74.08	$C_2H_6ON_2$
27 — uric acid	$C_6H_6N_4O_3.1\frac{1}{2}H_2O$	209.15	$C_6H_6O_3N_4$
28 Methylal	$H.CH(OCH_3)_2$	76.08	$C_3H_8O_2$
29 Methylene bromide	CH_2Br_2	173.86	CH_2Br_2
30 — chloride	CH_2Cl_2	84.94	CH_2Cl_2
32 — disulphonic acid	$CH_2(SO_3H)_2$	176.16	$CH_4O_6S_2$
32 — iodide	CH_2I_2	267.86	CH_2I_2
33 Milk sugar, lactose	$C_{12}H_{22}O_{11}.2H_2O$	378.27	$C_{12}H_{22}O_{11}$
34 Mono acetin	$C_3H_5(OH)_2O.COCH_3$	134.11	$C_5H_{10}O_4$
35 — thioglycerin, see	Glycerin mercaptan		
36 Morin	$C_{15}H_{10}O_7$	302.16	$C_{15}H_{10}O_7$

Density $H_2O=1$.	Solubility in Water.	Solubility in Alcohol.	Solubility in Ether.	M.P. °C.	B.P. °C.	
1.0974/15°				liq.	265	1
	s.s.	s.s.	v.s.	75	271	2
1.2322/5°	s.s.			liq.	65 expl.	3
0.991/15°				gas.	−12	4
	s.		s.	64		5
0.8295/17.5°				15	232	6
	h.s.s.	s.s.	v.s.	117	d. 350	7
	s.s.	v.s.	70 : 1 vol.	gas	−14/758.5	8
				105		9
						10
	i.	s.		liq.	181—182	11
0.863/16°	i.	s.		liq.	176—177.5	12
0.8682/0°	i.	s			183—184	13
0.865/16°	i.	s		− 25	175—176	14
0.87226/0°	i.	s.		−73.5	175	15
				129		16
					147—148/750	17
					142—143/742	18
0.845/21°				liq.	37.5	19
				d. 130		20
	v.s.	s.	an. m.	− 30 liq.		21
						22
	s.	s.	s.s.	118		23
1.069/37°					119	24
	s.s.	s.s	v.s.s.	320 d.		25
	v.s.	v.s.	v.s.	98		26
	1 : 2050 h.	s.s.		360 d.		27
0.855/18°	1 : 3			S.P.—104.8	42.3	28
2.4985/15°				liq.	98.5/756	29
1.3778/0°	i.			S.P.—96.7	41.6	30
	v.del.					31
3.3326/15°				5.7	180 d.	32
1.525/4°	17 : 100/10°	v.s.s.	i.	203.5	d. 208	33
1.2	s.s.			liq.	130—132 /2—3mm.	34
						35
	1 : 4000	s.	s.	285		36

	Name.	Formula.	Formula Weight.	Empirical Formula.
1	**Mucic acid**	$C_4H_4(OH)_4(COOH)_2$	210.11	$C_6H_{10}O_8$
2	**Muconic acid**	$C_6H_6O_4$	142.08	$C_6H_6O_4$
3	**Murexide**	$C_8H_4O_6N_5.NH_4.H_2O$	302.18	$C_8H_8O_6N_6$
4	**Myristic acid**	$C_{13}H_{27}COOH$	228.31	$C_{14}H_{28}O_2$
5	**Myristone**	$(C_{13}H_{27})_2:CO$	394.57	$C_{27}H_{54}O$
6	**Naphthalene**	$C_{10}H_8$	128.11	$C_{10}H_8$
7	— dicarboxylic acid	$C_{10}H_6(COOH)_2$ (1 : 5)	216.12	$C_{12}H_8O_4$
8	— — —, 1 : 8	,, ,,	216.12	,,
9	— sulphonic acid, *α*	$C_{10}H_7(SO_3H).H_2O$	226.19	$C_{10}H_8O_3S$
10	— — —, *β*	,, ,, $.H_2O$	226.19	,,
11	**Naphthazarin**	$C_{10}H_4O_2(OH)_2$	190.10	$C_{10}H_6O_4$
12	**Naphthazine**	$C_{10}H_6.N_2.C_{10}H_6$	280.32	$C_{20}H_{12}N_2$
13	**Naphthionic acid, 1 : 4**	$C_{10}H_6(NH_2)SO_3H.\frac{1}{2}H_2O$	232.20	$C_{10}H_9O_3NS$
14	**Naphthoic acid, *α***	$C_{10}H_7.COOH$	172.12	$C_{11}H_8O_2$
15	— —, *β*	,,	172.12	,,
16	— aldehyde, *α*	$C_{10}H_7.CHO$	156.12	$C_{11}H_8O$
17	— —, *β*	,,	156.12	,,
18	**Naphthol, *α***	$C_{10}H_7.OH$	144.11	$C_{10}H_8O$
19	—, *β*	,,	144.11	,,
20	— sulphonic acid, 1 : 4	$C_{10}H_6(OH)SO_3H$	224.17	$C_{10}H_8O_4S$
21	— — —, 1 : 5	,, ,,	224.17	,,
22	— — —, 1 : 8	,, ,, $.(H_2O)$	224.17	,,
23	— — —, 1 : 2	,, ,,	224.17	,,
24	**Naphtho nitrile, *α***	$C_{10}H_7CN$	153.12	$C_{11}H_7N$
25	— —, *β*	,,	153.12	,,
26	— phenazine, *α β*	$C_{10}H_6:N_2:C_6H_4$	230.18	$C_{16}H_{10}N_2$
27	— —, *β β*	,, ,,	230.18	,,
28	— quinaldine, *α*	$C_{13}H_8N.CH_3$ (2)	193.17	$C_{14}H_{11}N$
29	— —, *β*	,, ,, (3)	193.17	,,
30	— quinoline, *α*	$C_{13}H_9N$	179.15	$C_{13}H_9N$
31	— —, *β*	,,	179.15	,,
32	— quinone, 1 : 4	$C_{10}H_6O_2$	158.10	$C_{10}H_6O_2$
33	— —, 1 : 2	,,	158.10	,,
34	— sultone	$C_{10}H_6\left<\begin{smallmatrix}SO_2\\ \vert\\ O\end{smallmatrix}\right.$	206.16	$C_{10}H_6O_3S$
35	**Naphthylamine, *α***	$C_{10}H_7.NH_2$	143.13	$C_{10}H_9N$

Density $H_2O=1$.	Solubility in Water.	Solubility in Alcohol.	Solubility in Ether.	M.P. °C.	B.P. °C.	
	1 : 300/14°	i.		224		1
	1 : 5000	h.s.	s. acetic.	272 d.		2
	h.s.	i.				3
	s.s.	s.	s.	53.8	248/100mm.	4
0.8013/76.3°		s.		75		5
{ 1.145/4° 0.9673/95°	i.	5.29 : 100 /15°	v.s.	80.1	217.96	6
		h.s. (dil.)		> 286		7
		v.s.s. C_6H_6		d.		8
	v.s.	s.	s.s.	85—90		9
				124—125		10
	h.s.s.	s.	s.?., s. alk.	subl.		11
	s.s. $CHCl_3$	v.s.s.	v.s.s.	275—280		12
	1 : 4030/15°	v.s.s.	i.	d.		13
	h.s.s.	s.		160		14
	0.0058 : 100/25°	s.	s.	182	>300	15
	s.s.	s.			291.6	16
	h.s.s.	v.s.	v.s.	60		17
1.224/4°	h.s.s.	s.	s.	96	278—280	18
1.217/4°	h.s.s.	s.	s.	122	285—286	19
	v.s.			d. 170		20
	s.			110—120		21
	v.s.			107, an. 100		22
	del.			101		23
		v.s.		33.5	296.5	24
		v.s.	v.s.	66.5	304—305	25
1.425	s. C_6H_6	s.s.	s.s.	142	>360	26
				233		27
	h.s.s.			liq.	>300	28
	s.s.	s.	s	82	>300	29
	v.s.s.	v.s.	v.s.	52	352	30
	h.s.	v.s.	v.s.	93.5	349.5—350 /741mm.	31
	[illegible]., s. $CHCl_3$	s.	s. C_6H_6	125		32
	[illegible]., s. $CHCl_3$	s.	s. C_6H_6	d. 115—120		33
	s.s.	s.s.	s. C_6H_6, $CHCl_3$	154	>360	34
1.1011/50°	0.167 : 100, c	v.s.	v.s.	51	300	35

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Naphthyl amine, β	$C_{10}H_7.NH_2$	143.13	$C_{10}H_9N$
2 Naphthylene diamine, 1 : 2	$C_{10}H_6(NH_2)_2$	158.15	$C_{10}H_{10}N_2$
3 — —, 1 : 5	,, ,,	158.15	,,
4 — —, 1 : 8	,, ,,	158.15	,,
5 Naphthyl mercaptan, thionaphthol	$C_{10}H_7SH$	160.17	$C_{10}H_8S$
6 — phenyl ketone, *a*	$C_{10}H_7.CO.C_6H_5$	232.18	$C_{17}H_{12}O$
7 — — —, β	,, ,,	232.18	,,
8 — — methane, *a*	$C_{10}H_7.CH_2.C_6H_5$	218.20	$C_{17}H_{14}$
9 — — —, β	,, ,,	218.20	,,
10 Neurine	$C_2H_3N(CH_3)_3OH$	103.14	$C_5H_{13}ON$
11 Nicotidine, hexahydro bipyridyl	$C_{10}H_{14}N_2$	162.18	$C_{10}H_{14}N_2$
12 Nicotinic acid	$C_5H_4N.COOH$	123.08	$C_6H_5O_2N$
13 Nitracetanilide, *o*	$NO_2.C_6H_4.NH.COCH_3$	180.12	$C_8H_8O_3N_2$
14 —, *m*	,, ,,	180.12	,,
15 —, *p*	,, ,,	180.12	,,
16 Nitranilic acid	$C_6(NO_2)_2.O_2.(OH)_2$	230.07	$C_6H_2O_5N_2$
17 Nitraniline, *o*	$NO_2.C_6H_4.NH_2$	138.10	$C_6H_6O_2N_2$
18 —, *m*	,, ,,	138.10	,,
19 —, *p*	,, ,,	138.10	,,
20 Nitro alizarin, 4 :1 :2	$C_{14}H_5O_2(NO_2)(OH)_2$	285.14	$C_{14}H_7O_6$1'
21 — —, 3 : 1 : 2	,, ,,	285.14	,,
22 — anthraquinone, 1	$C_{14}H_7O_2.NO_2$	253.14	$C_{14}H_7O_4N$
23 — —, 2	,, ,,	253.14	,,
24 — benzamide, *o*	$C_6H_4(NO_2)CONH_2$	166.10	$C_7H_6O_3N_2$
25 — —, *m*	,, ,,	166.10	,,
26 — —, *p*	,, ,,	166.10	,,
27 — benzaldehyde, *a*	$C_6H_4(NO_2)CHO$	151.09	$C_7H_5O_3N$
28 — — *m*	,, ,,	151.09	,,
29 — —, *p*	,, ,,	151.09	,,
30 — benzene	$C_6H_5NO_2$	123.08	$C_6H_5O_2N$
31 — benzoic acid, *o*	$C_6H_4(NO_2)COOH$	167.09	$C_7H_5O_4N$
32 — — —, *m*	,, ,,	167.09	,,

Density $H_2O=1$.	Solubility in			M.P. °C.	B.P. °C.	
	Water.	Alcohol.	Ether.			
1.0614/98°	s			112	306.1	1
	h.s.	v.s.	s.	95		2
	h.s.	s. $CHCl_3$	s.	186	subl.	3
	s.	m.	m.	64	subl.	4
	i.			liq.	285 d	5
		(abs.) 1 : 41/12°		75.5	385	6
		(abs.) 1 : 49/12°		82	398/745mm.	7
	s. C_6H_6, CS_2	1 : 30, h.	s.	59	350	8
				35.5	350	9
	v.s.	s.	s.s.	liq.		10
	v.s.	v.s.	s.s	liq.	287—289	11
	h.s.	s.	i.	228—229		12
	h.v.s		v.s. KOH	92—93		13
	h.s.		i. KOH	150—152		14
			s. KOH	210—211		15
	v.s.	v.s.	i.	100	d. 170	16
	h.s.	s.	v.s.	71.5		17
1.430	1 :600/18.5°	11.26 :100	7.05 : 100	114	285	18
1.424	1 :1250/18.5°	5.84 :100	6.1 :100	148.3		19
	s.s.	s.	s. KOH	289 d.		20
	s.s.	v.s.	s. C_6H_6, $CHCl_3$	244 d.		21
		s.s.	s.s.	220	subl.	22
	i.	v.s.s.	v.s.s.	184—185	subl.	23
	h.s.	s.		174	317	24
	s.	s.		140—142	310—315	25
	s.s.	s.		197—198		26
	s.s.	s.	s.	46	153/23mm.	27
	h.s.	s.	s.	58	164/23mm.	28
	h.s.	s.	s.s.	106		29
1.1866/14°	i.	s.	s.	5.7	210.9	30
1.575/4°	0.611 : 100/16.5°	1 : 3/10°	2.16 : 7/11°	147—148		31
1.494/4°	0.235 : 100/16.5°	5 :9/10°	2.51 : 7/11°	140.4		32

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Nitro benzoic acid, *p*	$C_6H_4(NO_2)COOH$	167.09	$C_7H_5O_4N$
2 — benzonitrile, *o*	$C_6H_4(NO_2)CN$	148.08	$C_7H_4O_2N_2$
3 — —, *m*	,, ,,	148.08	,,
4 — —, *p*	,, ,,	148.08	,,
5 — benzoyl formate, *o*	$C_6H_4(NO_2)CO.COOH$	195.09	$C_8H_5O_5N$
6 — benzyl alcohol, *o*	$C_6H_4(NO_2).CH_2OH$	153.10	$C_7H_7O_3N$
7 — — —, *m*	,, ,,	153.10	,,
8 — — —, *p*	,, ,,	153.10	,,
9 — — chloride, *o*	$C_6H_4(NO_2)CH_2Cl$	171.55	$C_7H_6O_2NCl$
10 — — —, *m*	,, ,,	171.55	,,
11 — — —, *p*	,, ,,	171.55	,,
12 — benzylidine chloride, *m*	$C_6H_4(NO_2)CHCl_2$	206.01	$C_7H_5O_2NCl_2$
13 — — —, *p*	,,	206.01	,,
14 — bromoform	$C(NO_2)Br_3$	297.78	CO_2NBr_3
15 — camphor, *a*	$C_{10}H_{15}O.NO_2$	197.18	$C_{10}H_{15}O_3N$
16 — cinnamic acid, *o*	$C_6H_4(NO_2)CH:CH.COOH$	193.11	$C_9H_7O_4N$
17 — — —, *m*	,, ,,	193.11	,,
18 — — —, *p*	,, ,,	193.11	,,
19 — cinnamate, ethyl	$C_6H_4(NO_2)CH:CH.COOC_2H_5$	221.15	$C_{11}H_{11}O_4N$
20 — cumene	$C_6H_4(NO_2)CH:(CH_3)_2$	165.14	$C_9H_{11}O_2N$
21 — dimethyl aniline, *o*	$C_6H_4(NO_2)N:(CH_3)_2$	166.14	$C_8H_{10}O_2N_2$
22 — — —, *m*	,, ,,	166.14	,,
23 — — —, *p*	,, ,,	166.14	,,
24 — diphenyl, *o*	$C_6H_5.C_6H_4.NO_2$	199.14	$C_{12}H_9O_2N$
25 — —, *m*	,, ,,	199.14	,,
26 — —, *p*	,, ,,	199.14	,,
27 — ethane	$C_2H_5.NO_2$	75.06	$C_2H_5O_2N$
28 — erythrol	$C_4H_6(ONO_2)_4$	302.11	$C_4H_6O_{12}N_4$
29 — glycerin, tri-	$C_3H_5(ONO_2)_3$	227.09	$C_3H_5O_9N_3$
30 — —, di- $\alpha\gamma$	$C_3H_5(OH)(ONO_2)_2$	183.09	$C_3H_6O_7N_2$
31 — —, di-, $\alpha\beta$	,, ,,	183.09	,,
32 — —, mono-, α	$C_3H_5(OH)_2(ONO_2)$	137.08	$C_3H_7O_5N$
33 — —, mono, β	,, ,,	137.08	,,
34 — isatin	$C_8H_4NO_2.NO_2$	192.09	$C_8H_4O_4N_2$
35 — isoquinoline	$C_6H_3(NO_2):C_3H_3N.H_2O$	210.11	$C_9H_6O_2N_2$
36 — mannitol	$C_6H_8(ONO_2)_6$	452.15	$C_6H_8O_{18}N_6$

Density $H_2O=1$.	Solubility in— Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
	0.04 : 100/20°	0.18 : 9/10°	0.22 : 7/11°	237		1
	h.s., s. CH_2	s., s. $CHCl_3$	s. C_6H_6	109		2
	s.s.	s.	s.	115		3
	s.s.	h.s.	s. $CHCl_3$	147.5—148.5		4
	warm, m.			an. 123		5
	s.s.	s.	s.	74	168/20mm.	6
		s.	s.	27	175—180/3	7
	h.s.	s.	s.	93	185/12mm.	8
		s.		48—49		9
		s.		45—47	173—178/ 30—35mm.	10
		s.		71		11
		h.s.	s.	65		12
		s.	s.	46		13
2.8				10.2	127/48mm.	14
	s. $CHCl_3$	s.	s. C_6H_6	10.3		15
	i.	h.s.		240		16
				196—197		17
	n.s.s.	h.s.s.	s.s.	285—286		18
	v.s. C_6H_6	v.s.	v.s., v.s. CS_2	42		19
				liq.		20
					151—153/ 30—33mm.	21
	i.	s.	s.	60—61	280—285 d.	22
	i.	s.		162—163		23
				37	320	24
				61		25
	s. $CHCl_3$	h.s.	s	114—114.5	340	26
1.0582/13°	i.				114—114.8	27
	h.s.	s.		61	expl.	28
1.6009/15°	0.16 : 100	1 : 3.5	m.	13.3	expl. 260	29
1.47	7.7 : 100			liq.	146—148 /15 mm.	30
				liq.	146—148 /15 mm.	31
1.40	70 : 10	v.s.	v.s.	58	155—160 /15mm.	32
				54	155—160 /15mm.	33
	s.s.	s.	s. KOH	226—230		34
	h.s.	s.		110		35
1.604/0°	h.s.	1 : 34.4 /12.8°	1 : 24.4 /9°	108		36

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Nitro mesitylene, $(CH_3)_3:NO_2=1:3:5:2$	$C_6H_2(CH_3)_3NO_2$	165.14	$C_9H_{11}O_2N$
2 — methane	$CH_3.NO_2$	61.04	CH_3O_2N
3 — naphthalene, *a*	$C_{10}H_7.NO_2$	173.12	$C_{10}H_7O_2N$
4 — —, β	„	173.12	„
5 — naphthol, 1 : 2	$C_{10}H_6OH.NO_2$	189.12	$C_{10}H_7O_3N$
6 — —, 1 : 4	„ „	189.12	„
7 — —, 1 : 5	„ „	189.12	„
8 — —, 2 : 1	„ „	189.12	„
9 — —, 2 : 5	„ „	189.12	„
10 — —, 2 : 6	„ „	189.12	„
11 — naphthylamine, 1 : 2	$C_{10}H_6NH_2.NO_2$	188.13	$C_{10}H_8O_2N_2$
12 — —, 1 : 4	„ „	188.13	„
13 — —, 2 : 1	„ „	188.13	„
14 — —, 1 : 8	„ „	188.13	„
15 — —, 1 : 5	„ „	188.13	„
16 — —, 2 : 5	„ „	188.13	„
17 — —, 2 : 8	„ „	188.13	„
18 — phenol, *o*	$C_6H_4OH.NO_2$	139.08	$C_6H_5O_3N$
19 — —, *m*	„ „	139.08	„
20 — —, *p*	„ „	139.08	„
21 — phenyl propiolic acid, *o*	$C_6H_4(NO_2)C : C.COOH$	191.10	$C_9H_5O_4N$
22 — — — —, *p*	„ „	191.10	„
— phthalic acid, $COOH:COOH:NO_2=$			
23 1 : 2 : 3	$C_6H_3(NO_2)(COOH)_2$	211.11	$C_8H_5O_6N$
24 1 : 2 : 4	„ „	211.11	„
25 1 : 3 : 5	„ „	211.11	„
26 1 : 3 : 2	„ „	211.11	„
27 1 : 3 : 4	„ „	211.11	„
28 1 : 4 : 2	„ „	211.11	„
— pseudo cumene,			
29 $(CH_3)_3:NO_2=1:2:4:3$	$C_6H_2(NO_2)(CH_3)_3$	165.14	$C_9H_{11}O_2N$
30 1 : 2 : 4 : 5	„ „	165.14	„
31 1 : 2 : 4 : 6	„ „	165.14	„
32 — quinoline, 8	$C_9H_6N.NO_2$	174.11	$C_9H_6O_2N_2$
33 — —, 7	„	174.11	„
34 — —, 6	„	174.11	„

Density $H_2O=1$.	Solubility in— Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
	s. C_6H_6	s.	s.	41—42	255	1
1.1441/15°	s.s.		s. alk.	– 26.5	101/762mm.	2
1.331/4°				61	304	3
	s. $CHCl_3$	s.	s.	79	160—170 /15mm.	4
	v.s.s.	s.s. (dil.)		128		5
	h.s.	v.s.	s. acetic.	164		6
				171		7
				165		8
				103		9
				144—145		10
		s.		144		11
		s.	s. acetic.	191		12
	h.s.	s.		123—124		13
				96—97		14
	s.			118—119		15
				143.5		16
				103.5		17
1.2945/45.2°	h.s.	s.	s.	44.3	214	18
1.827/19°	h.s.	v.s.	v.s.	96	194/70mm.	19
1.2809/14°	s.s.	v.s.		114		20
	h.s.	s.	s., s.s. $CHCl_3$	155—156 d.		21
	s.s.	h.s.	s.	181	d.	22
	h.s.	v.s.	s.	218		23
	v.s.	v.s.	v.s.	161		24
	s.s.	v.s.		248—249		25
				315		26
				246		27
				270		28
		s.		30		29
		s.		71	265	30
				20		31
	h s.	s.	s., s. C_6H_6	88—89		32
		c.v.s.s.	s.	132—133		33
	h.s.	h.s.	s.s., s. C_6H_6	149—150	subl.	34

K

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Nitro quinoline, 5	$C_9H_6N.NO_2$	174.11	$C_9H_6O_2N_2$
— salicylic acid,			
$COOH : OH : NO_2=$			
2 1 : 2 : 6	$C_6H_3(NO_2)(OH)COOH$	183.09	$C_7H_5O_5N$
3 1 : 2 : 5	,,	183.09	,,
4 1 : 2 : 3	,, ,, $(.H_2O)$	183.09	,,
5 1 : 2 : 4	,, ,,	183.09	,,
6 1 : 3 : 2	,, ,, $(.H_2O)$	183.09	,,
7 1 : 3 : 4	,, ,,	183.09	,,
8 1 : 3 : 5	,, ,, $(.H_2O)$	183.09	,,
9 1 : 3 : 6	,, ,,	183.09	,,
10 1 : 4 : 3	,, ,,	183.09	,,
11 — styrolene, *o*	$C_6H_5.CH:CH.NO_2$	149.10	$C_8H_7O_2N$
12 — —, *m*	,, ,,	149.10	,,
13 — —, *p*	,, ,,	149.10	,,
14 — thiophen	$C_4H_3S.NO_2$	129.11	$C_4H_3O_2NS$
15 — tolune, *o*	$C_6H_4(NO_2)CH_3$	137.10	$C_7H_7O_2N$
16 — —, *m*	,, ,,	137.10	,,
17 — —, *p*	,, ,,	137.10	,,
— toludine,			
$CH_3:NH_2:NO_2=$			
18 1 : 2 : 3	$C_6H_3(CH_3)(NH_2)NO_2$	152.12	$C_7H_8O_2N_2$
19 1 : 2 : 4	,, ,,	152.12	,,
20 1 : 2 : 5	,, ,,	152.12	,,
21 1 : 3 : 4	,, ,,	152.12	,,
22 1 : 2 : 6	,, ,,	152.12	,,
23 1 : 3 : 2	,, ,,	152.12	,,
24 1 : 3 : 5	,, ,,	152.12	,,
25 1 : 3 : 6	,, ,,	152.12	,,
26 1 : 4 : 2	,, ,,	152.12	,,
27 1 : 4 : 3	,, ,,	152.12	,,
28 — urea	$NH_2.CO.NH.NO_2$	105.06	$CH_3O_3N_3$
29 — urethane	$C_2H_5.O.CO.NH.NO_2$	134.08	$C_3H_6O_4N_2$
— xylene,			
$CH_3 : CH_3 : NO_2=$			
30 1 : 2 : 3	$C_6H_3(CH_3)NO_2$	151.12	$C_8H_9O_2N$
31 1 : 2 : 4	,, ,,	151.12	,,

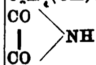
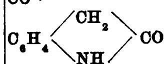
Density $H_2O=1$.	Solubility in— Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
	h.s.s.			72	subl.	1
	s. acetone	s.s.	v.s.s.	130		2
	1:1475 /15.5°	v.s.		228		3
	1:770 /15.5°	s.	s., s. C_6H_6	125, an. 144		4
				235		5
				178		6
				230		7
				167		8
				169		9
				185		10
	s. H_2SO_4			12—12.5	d.	11
	s. $CHCl_3$	s. (abs.)	s.	16	230—231	12
		s.	v.s.	58	250—260	13
	i. alk.			44	224—225	14
1.16[illegible]/20°	i.	s.		– 3.85	222.3	15
1.168/22°		s.		16.1	230—231 /756mm.	16
1.1232/54°		s.		51.6—51.9	237.7	17
	s. $CHCl_3$	s.	s., s. C_6H_6	91.5		18
	s. acetone	s.	s.	104—105		19
	h.s.s.	s.		127—128		20
				109		21
	h.s.s.	v.s.	s., v.s. C_6H_6	91.5		22
	c.s.s.	s.		53		23
	v.s.s.	s., s. C_6H_6	v.s.	98—98.4		24
			s. ac.	138		25
	s.	s.s. CS_2		77.5		26
	h.v.s.s.	s.		116		27
	s.	s.				28
	s.	s.	s	64	140 d.	29
1.147/15°				7—9	250/739mm.	30
1.139/30°		m. >30°		29	258	31

	Name.	Formula.	Formula Weight.	Empirical Formula.
	Nitro xylene, $CH_3 : CH_3 : NO_2 =$			
1	1 : 3 : 2	$C_6H_3(CH_3)_2NO_2$	151.12	$C_8H_9O_2N$
2	1 : 3 : 4	,, ,,	151.12	,,
3	1 : 3 : 5	,, ,,	151.12	,,
4	1 : 4 : 2	,, ,,	151.12	,,
5	Nitroform	$CH(NO_2)_3$	151.04	CHO_6N_3
6	Nitroso aniline, *p*	$C_6H_4(NO)NH_2$	122.10	$C_6H_6ON_2$
7	— benzene	$C_6H_5.NO$	107.08	C_6H_5ON
8	— dimethylaniline, *p*	$C_6H_4(NO)N:(CH_3)_2$	150.14	$C_8H_{10}ON_2$
9	— diphenylamine	$(C_6H_5)_2:N.NO$	198.16	$C_{12}H_{10}ON_2$
10	— indoxyl	$C_6H_4\left\langle\begin{matrix}N(NO)\\C(OH)\end{matrix}\right\rangle CH$	162.11	$C_8H_6O_2N_2$
11	— naphthol, 1 : 2	$C_{10}H_6OH.NO$	173.12	$C_{10}H_7O_2N$
12	— —, 1 : 4	,, ,,	173.12	,,
13	— —, 2 : 1	,, ,,	173.12	,,
14	Nonadecane	$C_{19}H_{40}$	268.42	$C_{19}H_{40}$
15	Nonane, norm.	$CH_3.(CH_2)_7.CH_3$	128.21	C_9H_{20}
16	—, isobutyl isoamyl	$(CH_3)_2:CH.(CH_2)_2.CH:(CH_3)_2$	128.21	,,
17	Nonyl alcohol, norm.	$C_9H_{19}OH$	144.21	$C_9H_{20}O$
18	— —, ethyl, hexyl carbinol	$C_2H_5.CHOH.C_6H_{13}$	144.21	,,
19	Nonylene	C_9H_{18}	126.15	C_9H_{18}
20	Nonylic acid	$C_8H_{17}COOH$	158.15	$C_9H_{18}O_2$
21	Nucin, see	Hydroxy naphthoquinone		,,
22	Octa decane	$C_{18}H_{38}$	254.39	$C_{18}H_{38}$
23	— decyl alcohol	$C_{18}H_{38}O$	270.39	$C_{18}H_{38}O$
24	— decylene, norm.	$CH_3.(CH_2)_{15}CH:CH_2$	252.38	$C_{18}H_{36}$
25	— —, sec.	$C_{18}H_{36}$	252.38	,,
26	Octane, norm.	C_8H_{18}	114.18	C_8H_{18}
27	—, di-isobutyl	$(CH_3)_2:CH.(CH_2)_3.CH:(CH_3)_2$	114.18	,,
28	Octyl alcohol, norm.	$C_8H_{18}O$	130.18	$C_8H_{18}O$
29	— —, methyl hexyl carbinol	$CH_3.(CH_2)_5.CHOH.CH_3$	130.18	,,
30	— —, diethyl propyl carbinol	$(C_2H_5)_2.COH.C_3H_7$	130.18	,,
31	— amine, norm.	$C_8H_{17}.NH_2$	129.20	$C_8H_{19}N$
32	— —, sec.	$CH_3.CH(NH_2)C_6H_{13}$	129.20	,,

Density $H_2O=1$.	Solubility in Water.	Solubility in Alcohol.	Solubility in Ether.	M.P. °C.	B.P. °C.	
1.112/15°				13	225/744mm.	1
1.126/17.5					237—239	2
		s.	s.	74—75	273/739mm.	3
1.132/15°				liq.	238.5—239 /739mm.	4
	s.		s. alk.		45—47/22	5
			s. C_6H_6	173—174		6
		s.	s.	68		7
	i.	s.	s.	85		8
		h..s	h.v.s. C_6H_6	66.5		9
	s.s.	s.		202		10
		s.	s. acetone.	162—164	d.	11
	h.v.s.s.	1 : 42/13°	s.	190		12
				112		13
0.777/32°				32	330	14
0.7177/20°				liq.	150	15
0.7247/0°					132—133	16
0.855/18.5°				– 5	213.5	17
0.825/20°				liq.	195/750mm.	18
0.7433/20°					147—148	19
	s.	s.	s.	12—12.5	254	20
						21
0.7668/28°				30	305—307	22
0.8124/59°		s.		59	210.5/15	23
0.791/18°				18	179/15mm.	24
0.942/15°	i.	v.s.s.	s, s. CS_2	63—64	440	25
0.7188/0°				liq.	125.8	26
0.7001/12°				liq.	108.5	27
0.8375/0°				– 15	195.5	28
0.823/16°					179.5	29
0.8379/20°					160.5	30
					185—187	31
0.786					162.5	32

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Octyl chloride, norm.	$C_8H_{17}Cl$	148.64	$C_8H_{17}Cl$
2 — —, sec.	"	148.64	..
3 Octylene, norm.	C_8H_{16}	112.17	C_8H_{16}
4 —, di-isopropyl ethylene	$(CH_3)_2:CH.CH:CH.CH:(CH_3)_2$	112.17	..
5 —, di-iso butylene	$(CH_3)_3.C:CH.C(CH_3)_3$	112.17	.
6 Œnanthic acid, see	Heptylic acid		
7 Œnanthine, see	Heptine		
8 Œnanthol, see	Heptyl alcohol		
9 Oleic acid	$C_{17}H_{33}COOH$	282.36	$C_{18}H_{34}O_2$
10 Olein	$C_3H_5(C_{18}H_{33}O_2)_3$	885.12	$C_{57}H_{104}O_6$
11 Opianic acid	$C_6H_2(OCH_3)_2(CHO)COOH$	210.13	$C_{10}H_{10}O_5$
12 Opianin, see	Narcotine		
13 Orceïne	$C_{28}H_{24}N_2O_7$	500.35	$C_{28}H_{24}O_7N_2$
14 Orcinol, see	Dihydroxy toluene		
15 — phthalein	$C_{22}H_{16}O_5$	360.24	$C_{22}H_{16}O_5$
16 Orsellic acid, 2:6:4:1	$C_6H_2(OH)_2(CH_3)COOH$	168.10	$C_8H_8O_4$
17 Osotriazole	HC=N╲ | NH HC=N╱	69.06	$C_2H_3N_3$
18 Oxalacetic ester	$C_2H_5.OOC.CO.CH_2.COO.C_2H_5$	188.14	$C_8H_{12}O_5$
19 Oxalic acid	$COOH.COOH.2H_2O$	126.06	$C_2H_2O_4$
20 Oxalate, ammonium	$(COONH_4)_2(.H_2O)$	124.09	$C_2H_8O_4N_2$
21 —, calcium	$(COO)_2Ca(.H_2O)$	134.08	C_2O_4Ca
22 —, potassium	$(COOK)_2(.H_2O)$	166.21	$C_2O_4K_2$
23 —, — hydrogen	$(COO)_2HK$	128.12	C_2HO_4K
24 —, — —	$(COO)_2HK(COOH)_2.2H_2O$	254.17	$C_4H_7O_{10}K$
25 —, allyl	$(COO.C_3H_5)_2$	170.12	$C_8H_{10}O_4$
26 —, ethyl	$(COO.C_2H_5)_2$	146.11	$C_6H_{10}O_4$
27 —, methyl	$(COO.CH_3)_2$	118.07	$C_4H_6O_4$
28 Oxaluramide	$C_3H_5N_3O_3$	131.09	$C_3H_5O_3N_3$
29 Oxaluric acid	$NH_2.CO.NH.CO.COOH$	132.07	$C_3H_4O_4N_2$
30 Oxalyl chloride	$(COCl)_2$	126.93	$C_2O_2Cl_2$
31 Oxamethane	$C_2O_2NH_2(OC_2H_5)$	117.09	$C_4H_7O_3N$
32 Oxamide	$C_2O_2(NH_2)_2$	88.06	$C_2H_4O_2N_2$
33 Oxaminic acid	$C_2O_2(NH_2)OH$	89.04	$C_2H_3O_3N_2$

Density $H_2O=1$.	Solubility in Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
0.8802/16°					179.5—180.5	1
0.8708/15°					175	2
0.7217/17°					122—123	3
				liq.	116—120	4
0.734/0°					102.5/756	5
						6
						7
						8
0.898/14°	i.	s.	s.	14	286/100	9
	i.	v.s.s.	v.s.	− 5		10
	1 : 400, c. 1 : 60, h.	s.	s.	150		11
						12
	s. $CHCl_3$	s.	s.			13
						14
	i.	s.	i., s. alk.	d. 230		15
	s.	v.s.	1 : 4.5/20°	d. 176		16
	m.			22.5	203—204 /714mm.	17
1.159/23.5°	i.	m.	m.	liq.	131—132 /24mm.	18
1.653/18.5°	1 : 10.46 /14.5°	1 : 2.5, c.	1.266 : 100/15°	98 an. 189.5		19
1.475	1 :23.7/15°					20
2.200	i.		s. ac.			21
2.080	1 : 3.03/16°					22
	s.s.					23
	1 : 26.21/8°					24
1.05/15°	i.	s.		liq.	206—207	25
1.0793/20°	s.s.	s.		− 40.6	184/740	26
1.1566	s.s.	s.		54	163.3	27
	c.i.	c.s. KOH	s. H_2SO_4	> 310		28
	c.v.s.s.					29
				− 12	64	30
0.806/19°				114—115		31
1.667	h.s.s.	s. NH_4OH		417—419		32
	1 : 58/17°, h.d.	i. (abs.)		d. 210		33

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Oxanilide	$C_2O_2(NH.C_6H_5)_2$	240.19	$C_{14}H_{12}O_2N_2$
2 Oxanthrol anthra-hydroquinone	$C_6H_4:(CO)CH(OH):C_6H_4$	210.15	$C_{14}H_{10}O_2$
3 Oxethylamine	$C_2H_4(OH)(NH_2)$	61.08	C_2H_7ON
4 Oximide		61.03	C_2HO_2N
5 Oxindole		133.11	C_8H_7ON
6 Palmitic acid	$C_{15}H_{31}COOH$	256.34	$C_{16}H_{32}O_2$
7 Palmitin	$C_3H_5(C_{16}H_{31}O_2)_3$	807.04	$C_{51}H_{98}O_6$
8 Palmitone	$(C_{15}H_{31})_2:CO$	450.65	$C_{31}H_{62}O$
9 Palmitonitrile	$C_{15}H_{31}CN$	237.34	$C_{16}H_{31}N$
10 Parabanic acid	$C_3H_2N_2O_3.H_2O$	132.07	$C_3H_2O_3N_2$
11 Para coniine	$C_8H_{15}N$	125.17	$C_8H_{15}N$
12 — conic acid	$CH_2:CH.COOH$ / $O.CO.CH_2$	130.07	$C_5H_6O_4$
13 — cyanogen	$(CN)_6$	156.12	C_6N_6
14 — formaldehyde	$(CH_2O)_2$	60.04	$C_2H_4O_2$
15 Paraldol	$(C_4H_8O_2)_2$	176.17	$C_8H_{16}O_4$
16 Paraldehyde	$C_6H_{12}O_3$	132.13	$C_6H_{12}O_3$
17 Para leucaniline	$CH(C_6H_4.NH_2)_3$	289.28	$C_{19}H_{19}N_3$
18 Param, dicyanogen diamide	$C_2N_2(NH_2)_2$	84.10	$C_2H_4N_4$
19 Para rosaniline	$C(OH)(C_6H_4.NH_2)_3$	305.28	$C_{19}H_{19}ON_3$
20 Parvolin, α	$C_9H_{13}N$	135.16	$C_9H_{13}N$
21 —, β	$C_5HN(CH_3)_4$	135.16	,,
22 —, 2-methyl-5-propyl pyridine	$C_5H_3N(CH_3)(C_3H_7)$	135.16	,,
23 —, 2 : 4-diethyl pyridine	$C_5H_3N(C_2H_5)_2$	135.16	,,
24 —, 3 : 5-dimethyl-2-ethyl pyridine	$C_5H_2N(CH_3)_2(C_2H_5)$	135.16	,,
25 —, 2 : 5-dimethyl-4-ethyl pyridine	,, ,,	135.16	,,
26 Pelargonic acid see	Nonylic acid		
27 Penta acetyl glucose, α	$C_6H_7O(C_2H_3O_2)_5$	390.26	$C_{16}H_{22}O_{11}$
28 — — —, β	,,	390.26	,,

Density $H_2O=1$.	Solubility in— Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
	h.i.	h.s.s.	i.	245	320	1
	s. alk.			204—206 d.		2
1.022/20°	m.	m.	v.s.s.	oil.	171	3
	o.v.s.s.	warm, s. dil. NH_4OH				4
	h.s.	s.		126		5
0.8527/64°	i.	s.s.	v.s.	62.6	278/100	6
				61.5		7
0.7997/82.8°						8
0.8224/31°				31	251.5/100	9
	1:21/8°		i.	242—244 d.		10
0.899/15°				liq.	168—170	11
	s.			57—58		12
	i.	i.	s. KOH		subl.	13
	s.			152		14
				80—90	90—100	15
0.998/15°	1:8			12.6	124	16
		s.		148		17
	s.	s.	s.s.	204		18
	i.	s.				19
0.986/22°				liq.	188	20
				liq.	220	21
1.066/0°	v.s.	s.	s.	liq.	>200	22
0.9338/0°	s.s.			liq.	187—188	23
0.9418/0°				liq.	198—200	24
0.916/14°	1:76/0°			liq.	186	25
						26
				111-112		27
				127—128		28

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Nitro mesitylene, $(CH_3)_3:NO_2=1:3:5:2$	$C_6H_2(CH_3)_3NO_2$	165.14	$C_9H_{11}O_2N$
2 — methane	$CH_3.NO_2$	61.04	CH_3O_2N
3 — naphthalene, α	$C_{10}H_7.NO_2$	173.12	$C_{10}H_7O_2N$
4 — —, β	,,	173.12	,,
5 — naphthol, 1 : 2	$C_{10}H_6OH.NO_2$	189.12	$C_{10}H_7O_3N$
6 — —, 1 : 4	,, ,,	189.12	,,
7 — —, 1 : 5	,, ,,	189.12	,,
8 — —, 2 : 1	,, ,,	189.12	,,
9 — —, 2 : 5	,, ,,	189.12	,,
10 — —, 2 : 6	,, ,,	189.12	,,
11 — naphthylamine, 1 : 2	$C_{10}H_6NH_2.NO_2$	188.13	$C_{10}H_8O_2N_2$
12 — —, 1 : 4	,, ,,	188.13	,,
13 — —, 2 : 1	,, ,,	188.13	,,
14 — —, 1 : 8	,, ,,	188.13	,,
15 — —, 1 : 5	,, ,,	188.13	,,
16 — —, 2 : 5	,, ,,	188.13	,,
17 — —, 2 : 8	,, ,,	188.13	,,
18 — phenol, *o*	$C_6H_4OH.NO_2$	139.08	$C_6H_5O_3N$
19 — —, *m*	,, ,,	139.08	,,
20 — —, *p*	,, ,,	139.08	,,
21 — phenyl propiolic acid, *o*	$C_6H_4(NO_2)C \vdots C.COOH$	191.10	$C_9H_5O_4N$
22 — — — —, *p*	,, ,,	191.10	,,
— phthalic acid, $COOH:COOH:NO_2=$			
23 1 : 2 : 3	$C_6H_3(NO_2)(COOH)_2$	211.11	$C_8H_5O_6N$
24 1 : 2 : 4	,, ,,	211.11	,,
25 1 : 3 : 5	,, ,,	211.11	,,
26 1 : 3 : 2	,, ,,	211.11	,,
27 1 : 3 : 4	,, ,,	211.11	,,
28 1 : 4 : 2	,, ,,	211.11	,,
— pseudo cumene,			
29 $(CH_3)_3:NO_2=1:2:4:3$	$C_6H_2(NO_2)(CH_3)_3$	165.14	$C_9H_{11}O_2N$
30 1 : 2 : 4 : 5	,, ,,	165.14	,,
31 1 : 2 : 4 : 6	,, ,,	165.14	,,
32 — quinoline, 8	$C_9H_6N.NO_2$	174.11	$C_9H_6O_2N_2$
33 — —, 7	,,	174.11	,,
34 — —, 6	,,	174.11	,,

Density $H_2O=1$.	Solubility in— Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
	s. C_6H_6	s.	s.	41—42	255	1
1.1441/15°	s.s.		s. alk.	– 26.5	101/762mm.	2
1.331/4°				61	304	3
	s. $CHCl_3$	s.	s.	79	160—170 /15mm.	4
	v.s.s.	s.s. (dil.)		128		5
	h.s.	v.s.	s. acetic.	164		6
				171		7
				165		8
				103		9
				144—145		10
		s.		144		11
		s.	s. acetic.	191		12
	h.s.	s.		123—124		13
				96—97		14
	s.			118—119		15
				143.5		16
				103.5		17
1.2945/45.2°	h.s.	s.	s.	44.3	214	18
1.827/19°	h.s.	v.s.	v.s.	96	194/70mm.	19
1.2809/14°	s.s.	v.s.		114		20
	h.s.	s.	s., s.s. $CHCl_3$	155—156 d.		21
	s.s.	h.s.	s.	181	d.	22
	h.s.	v.s.	s.	218		23
	v.s.	v.s.	v.s.	161		24
	s.s.	v.s.		248—249		25
				315		26
				246		27
				270		28
		s.		30		29
		s.		71	265	30
				20		31
	h s.	s.	s., s. C_6H_6	88—89		32
		c.v.s.s.	s.	132—133		33
	h.s.	h.s.	s.s., s. C_6H_6	149—150	subl.	34

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Nitro quinoline, 5	$C_9H_6N.NO_2$	174.11	$C_9H_6O_2N_2$
— salicylic acid, COOH : OH : NO_2 =			
2 1 : 2 : 6	$C_6H_3(NO_2)(OH)COOH$	183.09	$C_7H_5O_5N$
3 1 : 2 : 5	,,	183.09	,,
4 1 : 2 : 3	,, ,, $(.H_2O)$	183.09	,,
5 1 : 2 : 4	,, ,,	183.09	,,
6 1 : 3 : 2	,, ,, $(.H_2O)$	183.09	,,
7 1 : 3 : 4	,, ,,	183.09	,,
8 1 : 3 : 5	,, ,, $(.H_2O)$	183.09	,,
9 1 : 3 : 6	,, ,,	183.09	,,
10 1 : 4 : 3	,, ,,	183.09	,,
11 — styrolene, *o*	$C_6H_5.CH:CH.NO_2$	149.10	$C_8H_7O_2N$
12 — —, *m*	,, ,,	149.10	,,
13 — —, *p*	,, ,,	149.10	,,
14 — thiophen	$C_4H_3S.NO_2$	129.11	$C_4H_3O_2NS$
15 — tolune, *o*	$C_6H_4(NO_2)CH_3$	137.10	$C_7H_7O_2N$
16 — —, *m*	,, ,,	137.10	,,
17 — —, *p*	,, ,,	137.10	,,
— toludine, $CH_3:NH_2:NO_2$ =			
18 1 : 2 : 3	$C_6H_3(CH_3)(NH_2)NO_2$	152.12	$C_7H_8O_2N_2$
19 1 : 2 : 4	,, ,,	152.12	,,
20 1 : 2 : 5	,, ,,	152.12	,,
21 1 : 3 : 4	,, ,,	152.12	,,
22 1 : 2 : 6	,, ,,	152.12	,,
23 1 : 3 : 2	,, ,,	152.12	,,
24 1 : 3 : 5	,, ,,	152.12	,,
25 1 : 3 : 6	,, ,,	152.12	,,
26 1 : 4 : 2	,, ,,	152.12	,,
27 1 : 4 : 3	,, ,,	152.12	,,
28 — urea	$NH_2.CO.NH.NO_2$	105.06	$CH_3O_3N_3$
29 — urethane	$C_2H_5.O.CO.NH.NO_2$	134.08	$C_3H_6O_4N_2$
— xylene, $CH_3 : CH_3 : NO_2$ =			
30 1 : 2 : 3	$C_6H_3(CH_3)NO_2$	151.12	$C_8H_9O_2N$
31 1 : 2 : 4	,, ,,	151.12	,,

Density $H_2O=1$.	Solubility in Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
	h.s.s.			72	subl.	1
	s. acetone	s.s.	v.s.s.	130		2
	1:1475 /15.5°	v.s.		228		3
	1:770 /15.5°	s.	s., s. C_6H_6	125, an. 144		4
				235		5
				178		6
				230		7
				167		8
				169		9
				185		10
	s. H_2SO_4			12—12.5	d.	11
	s. $CHCl_3$	s. (abs.)	s.	16	230—231	12
		s.	v.s.	58	250—260	13
	i. alk.			44	224—225	14
1.1069/20°	i.	s.		− 3.85	222.3	15
1.168/22°		s.		16.1	230—231 /756mm.	16
1.1232/54°		s.		51.6—51.9	237.7	17
	s. $CHCl_3$	s.	s., s. C_6H_6	91.5		18
	s. acetone	s.	s.	104—105		19
	h.s.s.	s.		127—128		20
				109		21
	h.s.s.	v.s.	s., v.s. C_6H_6	91.5		22
	c.s.s.	s.		53		23
	v.s.s.	s., s. C_6H_6	v.s.	98—98.4		24
			s. ac.	138		25
	s.	s.s. CS_2		77.5		26
	h.v.s.s.	s.		116		27
	s.	s.				28
	s.	s.	s	64	140 d.	29
1.147/15°				7—9	250/739mm.	30
1.139/30°		m. >30°		29	256	31

	Name.	Formula.	Formula Weight.	Empirical Formula.
	Nitro xylene, $CH_3 : CH_3 : NO_2 =$			
1	1 : 3 : 2	$C_6H_3(CH_3)_2NO_2$	151.12	$C_8H_9O_2N$
2	1 : 3 : 4	,, ,,	151.12	,,
3	1 : 3 : 5	,, ,,	151.12	,,
4	1 : 4 : 2	,, ,,	151.12	,,
5	Nitroform	$CH(NO_2)_3$	151.04	CHO_6N_3
6	Nitroso aniline, *p*	$C_6H_4(NO)NH_2$	122.10	$C_6H_6ON_2$
7	— benzene	$C_6H_5.NO$	107.08	C_6H_5ON
8	— dimethylaniline, *p*	$C_6H_4(NO)N:(CH_3)_2$	150.14	$C_8H_{10}ON_2$
9	— diphenylamine	$(C_6H_5)_2:N.NO$	198.16	$C_{12}H_{10}ON_2$
10	— indoxyl	$C_6H_4\left\langle\begin{matrix}N(NO)\\C(OH)\end{matrix}\right\rangle CH$	162.11	$C_8H_6O_2N_2$
11	— naphthol, 1 : 2	$C_{10}H_6OH.NO$	173.12	$C_{10}H_7O_2N$
12	— —, 1 : 4	,, ,,	173.12	,,
13	— —, 2 : 1	,, ,,	173.12	,,
14	Nonadecane	$C_{19}H_{40}$	268.42	$C_{19}H_{40}$
15	Nonane, norm.	$CH_3.(CH_2)_7.CH_3$	128.21	C_9H_{20}
16	—, isobutyl isoamyl	$(CH_3)_2:CH.(CH_2)_2.CH:(CH_3)_2$	128.21	,,
17	Nonyl alcohol, norm.	$C_9H_{19}OH$	144.21	$C_9H_{20}O$
18	— —, ethyl, hexyl carbinol	$C_2H_5.CHOH.C_6H_{13}$	144.21	,,
19	Nonylene	C_9H_{18}	126.15	C_9H_{18}
20	Nonylic acid	$C_8H_{17}COOH$	158.15	$C_9H_{18}O_2$
21	Nucin, see	Hydroxy naphthoquinone		,,
22	Octa decane	$C_{18}H_{38}$	254.39	$C_{18}H_{38}$
23	— decyl alcohol	$C_{18}H_{38}O$	270.39	$C_{18}H_{38}O$
24	— decylene, norm.	$CH_3.(CH_2)_{15}CH:CH_2$	252.38	$C_{18}H_{36}$
25	— —, sec.	$C_{18}H_{36}$	252.38	,,
26	Octane, norm.	C_8H_{18}	114.18	C_8H_{18}
27	—, di-isobutyl	$(CH_3)_2:CH.(CH_2)_3.CH:(CH_3)_2$	114.18	,,
28	Octyl alcohol, norm.	$C_8H_{18}O$	130.18	$C_8H_{18}O$
29	— —, methyl hexyl carbinol	$CH_3.(CH_2)_5.CHOH.CH_3$	130.18	,,
30	— —, diethyl propyl carbinol	$(C_2H_5)_2.COH.C_3H_7$	130.18	,,
31	— amine, norm.	$C_8H_{17}.NH_2$	129.20	$C_8H_{19}N$
32	— —, sec.	$CH_3.CH(NH_2)C_6H_{13}$	129.20	,,

Density $H_2O=1$.	Solubility in Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
1.112/15°				13	225/744mm.	1
1.126/17.5					237—239	2
		s.	s.	74—75	273/739mm.	3
1.132/15°				liq.	238.5—239 /739mm.	4
	s.		s. alk.		45—47/22	5
			s. C_6H_6	173—174		6
		s.	s.	68		7
	i.	s.	s.	85		8
		h..s	h.v.s. C_6H_6	66.5		9
	s.s.	s.		202		10
		s.	s. acetone.	162—164	d.	11
	h.v.s.s.	1 : 42/13°	s.	190		12
				112		13
0.777/32°				32	330	14
0.7177/20°				liq.	150	15
0.7247/0°					132—133	16
0.855/18.5°				– 5	213.5	17
0.825/20°				liq.	195/750mm.	18
0.7433/20°					147—148	19
	s.	s.	s.	12—12.5	254	20
						21
0.7668/28°				30	305—307	22
0.8124/59°		s.		59	210.5/15	23
0.791/18°				18	179/15mm.	24
0.942/15°	i.	v.s.s.	s, s. CS_2	63—64	440	25
0.7188/0°				liq.	125.8	26
0.7001/12°				liq.	108.5	27
0.8375/0°				– 15	195.5	28
0.823/16°					179.5	29
0.8379/20°					160.5	30
					185—187	31
0.786					162.5	32

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Octyl chloride, norm.	$C_8H_{17}Cl$	148.64	$C_8H_{17}Cl$
2 — —, sec.	"	148.64	..
3 Octylene, norm.	C_8H_{16}	112.17	C_8H_{16}
4 —, di-isopropyl ethylene	$(CH_3)_2:CH.CH:CH.CH:(CH_3)_2$	112.17	..
5 —, di-iso butylene	$(CH_3)_3.C:CH.C(CH_3)_3$	112.17	.
6 Œnanthic acid, see	Heptylic acid		
7 Œnanthine, see	Heptine		
8 Œnanthol, see	Heptyl alcohol		
9 Oleic acid	$C_{17}H_{33}COOH$	282.36	$C_{18}H_{34}O_2$
10 Olein	$C_3H_5(C_{18}H_{33}O_2)_3$	885.12	$C_{57}H_{104}O_6$
11 Opianic acid	$C_6H_2(OCH_3)_2(CHO)COOH$	210.13	$C_{10}H_{10}O_5$
12 Opianin, see	Narcotine		
13 Orceïne	$C_{28}H_{24}N_2O_7$	500.35	$C_{28}H_{24}O_7N_2$
14 Orcinol, see	Dihydroxy toluene		
15 — phthalein	$C_{22}H_{16}O_5$	360.24	$C_{22}H_{16}O_5$
16 Orsellic acid, 2:6:4:1	$C_6H_2(OH)_2(CH_3)COOH$	168.10	$C_8H_8O_4$
17 Osotriazole	HC ═ N ╲ | NH HC ═ N ╱	69.06	$C_2H_3N_3$
18 Oxalacetic ester	$C_2H_5.OOC.CO.CH_2.COO.C_2H_5$	188.14	$C_8H_{12}O_5$
19 Oxalic acid	$COOH.COOH.2H_2O$	126.06	$C_2H_2O_4$
20 Oxalate, ammonium	$(COONH_4)_2(.H_2O)$	124.09	$C_2H_8O_4N_2$
21 —, calcium	$(COO)_2Ca(.H_2O)$	134.08	C_2O_4Ca
22 —, potassium	$(COOK)_2(.H_2O)$	166.21	$C_2O_4K_2$
23 —, — hydrogen	$(COO)_2HK$	128.12	C_2HO_4K
24 —, — —	$(COO)_2HK(COOH)_2.2H_2O$	254.17	$C_4H_3O_8K$
25 —, allyl	$(COO.C_3H_5)_2$	170.12	$C_8H_{10}O_4$
26 —, ethyl	$(COO.C_2H_5)_2$	146.11	$C_6H_{10}O_4$
27 —, methyl	$(COO.CH_3)_2$	118.07	$C_4H_6O_4$
28 Oxaluramide	$C_3H_5N_3O_3$	131.09	$C_3H_5O_3N_3$
29 Oxaluric acid	$NH_2.CO.NH.CO.COOH$	132.07	$C_3H_4O_4N_2$
30 Oxalyl chloride	$(COCl)_2$	126.93	$C_2O_2Cl_2$
31 Oxamethane	$C_2O_2NH_2(OC_2H_5)$	117.09	$C_4H_7O_3N$
32 Oxamide	$C_2O_2(NH_2)_2$	88.06	$C_2H_4O_2N_2$
33 Oxaminic acid	$C_2O_2(NH_2)OH$	89.04	$C_2H_3O_3N$

Density H_2O=1.	Solubility in Water.	Solubility in Alcohol.	Solubility in Ether.	M.P. °C.	B.P. °C.	
0.8802/16°					179.5—180.5	1
0.8708/15°					175	2
0.7217/17°					122—123	3
				liq.	116—120	4
0.734/0°					102.5/756	5
						6
						7
						8
0.898/14°	i.	s.	s.	14	286/100	9
	i.	v.s.s.	v.s.	− 5		10
	1 : 400, c. 1 : 60, h.	s.	s.	150		11
						12
	s. $CHCl_3$	s.	s.			13
						14
	i.	s.	i., s. alk.	d. 230		15
	s.	v.s.	1 : 4.5/20°	d. 176		16
	m.			22.5	203—204 /714mm.	17
1.159/23.5°	i.	m.	m.	liq.	131—132 /24mm.	18
1.653/18.5°	1 : 10.46 /14.5°	1 : 2.5, c.	1.266 : 100/15°	98 an. 189.5		19
1.475	1 :23.7/15°					20
2.200	i.		s. ac.			21
2.080	1 : 3.03/16°					22
	s.s.					23
	1 : 26.21/8°					24
1.05/15°	i.	s.		liq.	206—207	25
1.0793/20°	s.s.	s.		− 40.6	184/740	26
1.1566	s.s.	s.		54	163.3	27
	c.i.	c.s. KOH	s. H_2SO_4	> 310		28
	c.v.s.s.					29
				− 12	64	30
0.808/19°				114—115		31
1.667	h.s.s.	s. NH_4OH		417—419		32
	1 : 58/17°, h.d.	i. (abs.)		d. 210		33

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Octyl chloride, norm.	$C_8H_{17}Cl$	148.64	$C_8H_{17}Cl$
2 — —, sec.	„	148.64	..
3 Octylene, norm.	C_8H_{16}	112.17	C_8H_{16}
4 —, di-isopropyl ethylene	$(CH_3)_2:CH.CH:CH.CH:(CH_3)_2$	112.17	..
5 —, di-iso butylene	$(CH_3)_3.C:CH.C(CH_3)_2$	112.17	.
6 Œnanthic acid, see	Heptylic acid		
7 Œnanthine, see	Heptine		
8 Œnanthol, see	Heptyl alcohol		
9 Oleic acid	$C_{17}H_{33}COOH$	282.36	$C_{18}H_{34}O_2$
10 Olein	$C_3H_5(C_{18}H_{33}O_2)_3$	885.12	$C_{57}H_{104}O_6$
11 Opianic acid	$C_6H_2(OCH_3)_2(CHO)COOH$	210.13	$C_{10}H_{10}O_5$
12 Opianin, see	Narcotine		
13 Orceïne	$C_{28}H_{24}N_2O_7$	500.35	$C_{28}H_{24}O_7N_2$
14 Orcinol, see	Dihydroxy toluene		
15 — phthalein	$C_{22}H_{16}O_5$	360.24	$C_{22}H_{16}O_5$
16 Orsellic acid, 2 :6 :4 :1	$C_6H_2(OH)_2(CH_3)COOH$	168.10	$C_8H_8O_4$
17 Osotriazole	HC ═N ╲ │ ╱NH HC ═N ╱	69.06	$C_2H_3N_3$
18 Oxalacetic ester	$C_2H_5.OOC.CO.CH_2.COO.C_2H_5$	188.14	$C_8H_{12}O_5$
19 Oxalic acid	$COOH.COOH.2H_2O$	126.06	$C_2H_2O_4$
20 Oxalate, ammonium	$(COONH_4)_2(.H_2O)$	124.09	$C_2H_8O_4N_2$
21 —, calcium	$(COO)_2Ca(.H_2O)$	134.08	C_2O_4Ca
22 —, potassium	$(COOK)_2(.H_2O)$	166.21	$C_2O_4K_2$
23 —, — hydrogen	$(COO)_2HK$	128.12	C_2HO_4K
24 —, — —	$(COO)_2HK(COOH)_2.2H_2O$	254.17	$C_4H_3O_8K$
25 —, allyl	$(COO.C_3H_5)_2$	170.12	$C_8H_{10}O_4$
26 —, ethyl	$(COO.C_2H_5)_2$	146.11	$C_6H_{10}O_4$
27 —, methyl	$(COO.CH_3)_2$	118.07	$C_4H_6O_4$
28 Oxaluramide	$C_3H_5N_3O_3$	131.09	$C_3H_5O_3N_3$
29 Oxaluric acid	$NH_2.CO.NH.CO.COOH$	132.07	$C_3H_4O_4N_2$
30 Oxalyl chloride	$(COCl)_2$	126.93	$C_2O_2Cl_2$
31 Oxamethane	$C_2O_2NH_2(OC_2H_5)$	117.09	$C_4H_7O_3N$
32 Oxamide	$C_2O_2(NH_2)_2$	88.06	$C_2H_4O_2N_2$
33 Oxaminic acid	$C_2O_2(NH_2)OH$	89.04	$C_2H_3O_3N_2$

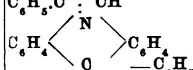
Density $H_2O=1$.	Solubility in— Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
0.8802/16°					179.5—180.5	1
0.8708/15°					175	2
0.7217/17°					122—123	3
				liq.	116—120	4
0.734/0°					102.5/756	5
						6
						7
						8
0.898/14°	i.	s.	s.	14	286/100	9
	i.	v.s.s.	v.s.	– 5		10
	1 : 400, c. 1 : 60, h.	s.	s.	150		11
						12
	s. $CHCl_3$	s.	s.			13
						14
	i.	s.	i., s. alk.	d. 230		15
	s.	v.s.	1 : 4.5/20°	d. 176		16
	m.			22.5	203—204 /714mm.	17
1.159/23.5°	i.	m.	m.	liq.	131—132 /24mm.	18
1.653/18.5°	1 : 10.46 /14.5°	1 : 2.5, c.	1.266 : 100/15°	98 an. 189.5		19
1.475	1 :23.7/15°					20
2.200	i.		s. ac.			21
2.080	1 : 3.03/16°					22
	s.s.					23
	1 : 26.21/8°					24
1.05/15°	i.	s.		liq.	206—207	25
1.0793/20°	s.s.	s.		– 40.6	184/740	26
1.1566	s.s.	s.		54	163.3	27
	c.i.	c.s. KOH	s. H_2SO_4	> 310		28
	c.v.s.s.					29
				– 12	64	30
0.806/19°				114—115		31
1.667	h.s.s.	s. NH_4OH		417—419		32
	1 : 58/17°, h.d.	i. (abs.)		d. 210		33

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Oxanilide	$C_2O_2(NH.C_6H_5)_2$	240.19	$C_{14}H_{12}O_2N_2$
2 Oxanthrol anthra-hydroquinone	$C_6H_4:(CO)\dot{C}H(\dot{O}H):C_6H_4$	210.15	$C_{14}H_{10}O_2$
3 Oxethylamine	$C_2H_4(OH)(NH_2)$	61.08	C_2H_7ON
4 Oximide	$\left.\begin{matrix}CO \\ \vert \\ CO\end{matrix}\right\rangle NH$	61.03	C_2HO_2N
5 Oxindole	$C_6H_4\left\langle\begin{matrix}CH_2 \\ NH\end{matrix}\right\rangle CO$	133.11	C_8H_7ON
6 Palmitic acid	$C_{15}H_{31}COOH$	256.34	$C_{16}H_{32}O_2$
7 Palmitin	$C_3H_5(C_{16}H_{31}O_2)_3$	807.04	$C_{51}H_{98}O_6$
8 Palmitone	$(C_{15}H_{31})_2:CO$	450.65	$C_{31}H_{62}O$
9 Palmitonitrile	$C_{15}H_{31}CN$	237.34	$C_{16}H_{31}N$
10 Parabanic acid	$C_3H_2N_2O_3.H_2O$	132.07	$C_3H_2O_3N_2$
11 Para coniine	$C_8H_{15}N$	125.17	$C_8H_{15}N$
12 — conic acid	$\dot{C}H_2:CH.COOH$ $\dot{O}.CO.\dot{C}H_2$	130.07	$C_5H_6O_4$
13 — cyanogen	$(CN)_6$	156.12	C_6N_6
14 — formaldehyde	$(CH_2O)_2$	60.04	$C_2H_4O_2$
15 Paraldol	$(C_4H_8O_2)_2$	176.17	$C_8H_{16}O_4$
16 Paraldehyde	$C_6H_{12}O_3$	132.13	$C_6H_{12}O_3$
17 Para leucaniline	$CH(C_6H_4.NH_2)_3$	289.28	$C_{19}H_{19}N_3$
18 Param, dicyanogen diamide	$C_2N_2(NH_2)_2$	84.10	$C_2H_4N_4$
19 Para rosaniline	$C(OH)(C_6H_4.NH_2)_3$	305.28	$C_{19}H_{19}ON_3$
20 Parvolin, α	$C_9H_{13}N$	135.16	$C_9H_{13}N$
21 —, β	$C_5HN(CH_3)_4$	135.16	,,
22 —, 2-methyl-5-propyl pyridine	$C_5H_3N(CH_3)(C_3H_7)$	135.16	,,
23 —, 2 : 4-diethyl pyridine	$C_5H_3N(C_2H_5)_2$	135.16	,,
24 —, 3 : 5-dimethyl-2-ethyl pyridine	$C_5H_2N(CH_3)_2(C_2H_5)$	135.16	,,
25 —, 2 : 5-dimethyl-4-ethyl pyridine	,, ,,	135.16	,,
26 Pelargonic acid see	Nonylic acid		
27 Penta acetyl glucose, α	$C_6H_7O(C_2H_3O_2)_5$	390.26	$C_{16}H_{22}O_{11}$
28 — — —, β	,,	390.26	,,

Density $H_2O=1$.	Solubility in Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
	h.i.	h.s.s.	i.	245	320	1
	s. alk.			204—206 d.		2
1.023/20°	m.	m.	v.s.s.	oil.	171	3
	o.v.s.s.	warm, s. dil. NH_4OH				4
	h.s.	s.		126		5
0.8527/64°	i.	s.s.	v.s.	62.6	278/100	6
				61.5		7
0.7997/82.8°						8
0.8224/31°				31	251.5/100	9
	1:21/8°		i.	242—244 d.		10
0.899/15°				liq.	168—170	11
	s.			57—58		12
	i.	i.	s. KOH		subl.	13
	s.			152		14
				80—90	90—100	15
0.998/15°	1 : 8			12.6	124	16
		s.		148		17
	s.	s.	s.s.	204		18
	i.	s.				19
0.986/22°				liq.	188	20
				liq.	220	21
1.066/0°	v.s.	s.	s.	liq.	>200	22
0.9338/0°	s.s.			liq.	187—188	23
0.9418/0°				liq.	198—200	24
0.916/14°	1 : 76/0°			liq.	186	25
						26
				111-112		27
				127—128		28

	Name.	Formula.	Formula Weight.	Empirical Formula.
1	Penta amino benzene	$C_6H(NH_2)_5$	153.17	$C_6H_{11}N_5$
2	— bromo benzene	C_6HBr_5	472.64	C_6HBr_5
3	— chlor aniline	$C_6Cl_5.NH_2$	265.36	$C_6H_2NCl_5$
4	— — benzene	C_6HCl_5	250.34	C_6HCl_5
5	— — ethane	C_2HCl_5	202.32	C_2HCl_5
6	— erythrite	$C(CH_2OH)_4$	136.12	$C_5H_{12}O_4$
7	— glycol	$(CH_3)_2C:(CH_2OH)_2$	104.12	$C_5H_{12}O_2$
8	— methyl amino benzene	$C_6(CH_3)_5NH_2$	163.20	$C_{11}H_{17}N$
9	— — benzene	$C_6H(CH_3)_5$	148.18	$C_{11}H_{16}$
10	— — ethol	$(CH_3)_3C.C(OH)(CH_3)_2$	116.16	$C_7H_{16}O$
11	— — — hydrate	$2C_7H_{16}O.H_2O$	250.35	$C_{14}H_{34}O_3$
12	— methylene	$CH_2.CH_2$ $>CH_2$ $CH_2.CH_2$	70.11	C_5H_{10}
13	— — bromide	$CH_2Br.(CH_2)_3.CH_2Br$	229.95	$C_5H_{10}Br_2$
14	— — diamine, cadaverine	$NH_2.CH_2.(CH_2)_3.CH_2.NH_2$	102.16	$C_5H_{14}N_2$
15	— — dicaboxylic acid, 1 : 3	$C_5H_8(COOH)_2$	158.12	$C_7H_{10}O_4$
16	— methyl phenol	$C_6OH(CH_3)_5$	164.18	$C_{11}H_{16}O$
17	— — rosaniline	$C_{24}H_{29}N_3O$	375.38	$C_{24}H_{29}O_3N$
18	Pentadiene, see	Piperylene		
19	Pentane, norm.	$CH_3.(CH_2)_3.CH_3$	72.12	C_5H_{12}
20	—, sec.	$(CH_3)_2:CH.CH_2.CH_3$	72.12	,,
21	—, tert.	$C(CH_3)_4$	72.12	,,
22	Pentahydroxy pentane	$C_5H_7(OH)_5$	152.12	$C_5H_{12}O_5$
23	Per chlor benzene	C_6Cl_6	284.79	C_6Cl_6
24	— — ethane	C_2Cl_6	236.77	C_2Cl_6
25	— — ether	$C_4Cl_{10}O$	418.62	C_4OCl_{10}
26	— — ethylene	$CCl_2:CCl_2$	165.85	C_2Cl_4
27	— — methyl mercaptan	$CCl_3.SCl$	185.90	CCl_4S
28	— thiocyanic acid	$C_2N_2H_2S_3$	150.23	$C_2H_2N_2S_3$
29	Phellandrene	$C_{10}H_{16}$	136.18	$C_{10}H_{16}$
30	Phenacitin	$C_6H_4(OC_2H_5)NH.CO.CH_3$	179.16	$C_{10}H_{13}O_2N$
31	Phenanthra hydroquinone, 9 : 10	$C_{14}H_8(OH)_2$	210.15	$C_{14}H_{10}O_2$

Density $H_2O=1$.	Solubility in Water.	Solubility in Alcohol.	Solubility in Ether.	M.P. °C.	B.P. °C.	
	v.s.	i.	i.			1
		s.		158		2
		s.	s.	232		3
1.8342/16.5°				85—86	275—277	4
1.709/0°				<—18	160.5	5
				253		6
	s.			129	206/747mm.	7
	i.	s.	s.	151—152	277—278	8
				53	230	9
				17	131	10
	s.s.			83		11
0.751/20°					49—50 /750mm.	12
				- 34.5	204—206	13
0.8846/15°	s.	s.	s.s.		178—179	14
				121	214	15
				125	267	16
	i.	s.	i.	130		17
						18
0.6337/15				liq.	36.15	19
0.6382/14°				liq.	27.95	20
					9.5	21
				102		22
1.569/236°				227	326	23
2.011					185 (corr.)	24
1.19/14.5°				69	d.	25
1.619/20°					119.5—120.5 /747.3mm.	26
1.712/12.8°	i.				146.5—148	27
	1 : 100	s.	s., s. $CHCl_3$			28
0.8558/10°		i.	s.		175—176 /755mm.	29
	1 : 70, h.	s.		135		30
	h.s.	v.s.	v.s.	145—147		31

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Phenanthra quinone	$C_{14}H_8O_2$ (9 : 10)	208.13	$C_{14}H_8O_2$
2 Phenanthrene	$C_6H_4.CH$ ‖ ‖ $C_6H_4.CH$	178.15	$C_{14}H_{10}$
3 Phenanthron, 9	$C_{14}H_9(OH)$	194.15	$C_{14}H_{10}O$
4 Phenazine	$C_6H_4:N.N:C_6H_4$	180.14	$C_{12}H_8N_2$
5 Phenethylamine, *β*	$C_6H_5.CH_2.CH_2.NH_2$	121.14	$C_8H_{11}N$
6 —, *a*	$C_6H_5.CH(NH_2).CH_3$	121.14	,,
7 Phenetidine, *o*	$C_2H_5O.C_6H_4.NH_2$	137.14	$C_8H_{11}ON$
8 —, *m*	,, ,,	137.14	,,
9 —, *p*	,, ,,	137.14	,,
10 Phenetol	$C_2H_5.O.C_6H_5$	122.12	$C_8H_{10}O$
11 Phenol	C_6H_5OH	94.08	C_6H_6O
12 — phthalein	$(C_6H_4OH)_2:C(COO):C_6H_4$	318.21	$C_{20}H_{14}O_4$
13 — phthaline	$(C_6H_4OH)_2:CH.C_6H_4.COOH$	320.23	$C_{20}H_{16}O_4$
14 — sulphonic acid, *o*	$C_6H_4OH.SO_3H$	174.14	$C_6H_6O_4S$
15 — — —, *m*	,, ,, $.2H_2O$	210.17	,,
16 — — —, *p*	,, ,,	174.14	,,
17 — tricarboxylic acid, 5 : 1 : 2 : 4	$C_6H_2OH(COOH)_3$	226.09	$C_9H_6O_7$
18 — — —, 2 : 1 : 3 : 5	,, ,,	226.09	,,
19 Phenoquinone	$C_6H_4O_2.2C_6H_6O$	296.22	$C_{18}H_6O_4$
20 Phenoxazine		183.14	$C_{12}H_9ON$
21 Phenthiazine, thiodiphenylamine		199.20	$C_{12}H_9NS$
22 Phenyl acetic acid	$C_6H_5.CH_2.COOH$	136.10	$C_8H_8O_2$
23 — acetylene	$C_6H_5.C : CH$	102.19	C_8H_6
24 — acridine, 9		255.21	$C_{19}H_{13}N$
25 — amino propionic acid, *β a*, rac.	$C_6H_5.CH_2.CH(NH_2)COOH$	165.14	$C_9H_{11}O_2N$
26 — — — —, *β β*	$C_6H_5.CH(NH_2).CH_2.COOH$	165.14	,,
27 — angelic acid	$C_6H_5.CH:C(C_2H_5)COOH$	176.15	$C_{11}H_{12}O_2$
28 — anthracene, 9	$C_{14}H_9.C_6H_5$	254.21	$C_{20}H_{14}$
29 — benzene, see	Diphenyl		

Density $H_2O=1$.	Solubility in Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
1.404	h.s.s.	s.s.	s.s., s. C_6H_6	205	>360	1
1.063/100°	i.	1 : 50/14°	s.	99—99.5, subl. 95—96	340	2
	s.	v.s.	v.s.	148—149		3
	v.s.s.	h.s.	s.	171	>360	4
0.9580/24°	s.	s.	s.	liq.	198	5
0.9395/15°	1 : 24/20°			liq.	183—185	6
		s.		liq.	228	7
		s.		liq.	180—205 /100mm.	8
		s.		2.4	244	9
0.9702/15°		s.		– 34	171	10
1.0489/50°	5.1 : 100/25°	m.	m.	42.5—43	181	11
	h.s.s	h.s.	s.	253—255, amorph. 100		12
	s.			225		13
	v.s.	v.s.				14
	s.	s.				15
	s.	s.				16
	1 : 200/10°	h.s.	s.s.	an. 245 d.		17
				312 d.		18
	c.s.	s.	s.	71		19
		v.s.	v.s.	148		20
	s. C_6H_6	c.s.s.	s.	180—181	371	21
1.0809/80°	h.s.	s.	s.	77.5—78	262—263 /751mm.	22
0.9295/20°				liq.	141.6	23
	s. C_6H_6	h.s.	s.	181—183	403—404	24
	c.s.s.	h.v.s.s.	i.	263		25
	c.s.s.	s.s.	i.	234—235		26
	c.v.s.s.	s.		104		27
	s. C_6H_6	h.s.	s.	152—153	417	28
						29

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Phenyl benzoic acid, see	Diphenyl carboxylic acid		
2 — butyric acid, *a*	$C_6H_5(CH_2)_3.COOH$	164.12	$C_{10}H_{12}O_2$
3 — — —, *β*, *d*	$CH_3.CH(C_6H_5).CH_2.COOH$	164.12	,,
4 — — —, *β*, *l*	,, ,,	164.12	,,
5 — — —, *β*, *r*	,, ,,	164.12	,,
6 — carbylamine	$C_6H_5.NC$	103.09	C_7H_5N
7 — cinnamic acid, *a*	$C_6H_5.CH:C(C_6H_5)COOH$	224.17	$C_{15}H_{12}O_2$
8 — — —, *β*	$C_6H_5.C(C_6H_5):CH.COOH$	224.17	,,
9 — crotonic acid	$C_6H_5.CH:C(CH_3)COOH$	162.13	$C_{10}H_{10}O_2$
10 — cyanamide	$NC.NH.C_6H_5$	106.10	$C_7H_6N_2$
11 — dihydroquinazoline	$C_6H_4 \langle$ $CH_2.N.C_6H_5$ / $N : CH$	208.19	$C_{14}H_{12}N_2$
12 — disulphide	$(C_6H_5)_2S_2$	218.26	$C_{12}H_{10}S_2$
13 — di tolyl methane	$(CH_3.C_6H_4)_2:CH.C_6H_5$	272.27	$C_{21}H_{20}$
14 — ether	$C_6H_5.O.C_6H_5$	170.14	$C_{12}H_{10}O$
15 — ethyl alcohol, norm.	$C_6H_5.CH_2.CH_2OH$	122.12	$C_8H_{10}O$
16 — — —, sec, inactive	$C_6H_5.CHOH.CH_3$	122.12	,,
17 — — —, —, active	,, ,,	122.12	,,
18 — formanilide	$C_6H_5N(C_6H_5)COH$	197.16	$C_{13}H_{11}ON$
19 — glucosazone, *β*	$C_{18}H_{22}N_4O_4$	358.31	$C_{18}H_{22}O_4N_4$
20 — —, *a*	,, ,,	358.31	,,
21 — glycine	$C_6H_5.NH.CH_2.COOH$	151.12	$C_8H_9O_2N$
22 — — carboxylic acid	$COOH.C_6H_4.NH.CH_2.COOH$	195.13	$C_9H_9O_4N$
23 — hydrazine	$C_6H_5.NH.NH_2.\frac{1}{2}H_2O$	117.12	$C_6H_8N_2$
23 — hydroxylamine, *β*	$C_6H_5.NH.OH$	109.10	C_6H_7ON
25 — isoamyl ether	$C_6H_5.O.C_5H_{11}$	164.18	$C_{11}H_{16}O$
26 — isocrotonic acid	$C_6H_5.CH:CH.CH_2.COOH$	162.13	$C_{10}H_{10}O_2$
27 — isopropyl ketone	$C_6H_5.CO.CH:(CH_3)_2$	148.15	$C_{10}H_{12}O$
28 — lactic acid, *a*	$C_6H_5.CH_2.CHOH.COOH$	166.13	$C_9H_{10}O_3$
29 — — —, *β*	$C_6H_5.CHOH.CH_2.COOH$	166.13	,,
30 — mercaptan	$C_6H_5.SH$	110.14	C_6H_6S
31 — methyl pyrazolone	$C_{10}H_{10}N_2O$	174.15	$C_{10}H_{10}ON_2$
32 — naphthalene, *a*	$C_6H_5.C_{10}H_7$	204.18	$C_{16}H_{12}$
33 — —, *β*	,,	204.18	,,
34 — naphthylamine, *a*	$C_{10}H_7.NH.C_6H_5$	219.19	$C_{16}H_{13}N$
35 — —, *β*	,, ,,	219.19	,,
36 — nitramine	$C_6H_5.NH.NO_2$	138.10	$C_6H_6O_2N_2$
37 — oxycrotonic acid, *a*	$C_6H_5.CH:CH.CHOH.COOH$	178.13	$C_{10}H_{10}O_3$

Density $H_2O=1$.	Solubility in— Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
						1
	h.s.	s.	s.	42	270—272	2
					155.5—156	3
					157.2—157.7	4
				47	270	5
0.9775/15°					165—166 d.	6
	c.s.s.	s.	s.	169—170	subl.	7
				159—161		8
	s. C_6H_6	s.	s.	74	288	9
	s.s.	s.	s.	47		10
	i.	s.	s.	93		11
	i.	s.	v.s.	60—61	310	12
	v.s. $CHCl_3$	v.s. CS_2	v.s., v.s.	53		13
	i.	s.	s. C_6H_6	28	257	14
1.0337/21°		s. (dil.)		liq.	212	15
1.013	i.			liq.	202—204	16
					203	17
		s.		73—74	210—220 in vac.	18
	v.s.s.	h.v.s.		205		19
				145		20
	s.	s.s.	v.s.s.	126—127		21
	h.s.	s.	s.	207 d.		22
1.0981/20°	h.s.	m.	m.	19.6	243.5	23
	1 : 10, h.	v.s.	v.s.	80—81		24
0.9198/21°				liq.	215	25
	h.s.s.	v.s.	v.s.	86	302	26
					220/746mm.	27
	s.			97—98		28
	s.v.s., h.m.			93		29
1.078/24°	i.	s.	s.	liq.	172.5	30
	h.s.	h.s.	v.s.s.	127	287/205mm.	31
	s. C_6H_6	s.	s.	0	324—325	32
	s. C_6H_6	h.s.		102—102.5	345—346	33
	s. CH_3OH	s.	s.	62	335/258mm.	34
	s. CH_3OH	s.	s.	107.5—108	395—395.5	35
				46	98	36
	s. C_6H_6	s.	s.	137		37

	Name.	Formula.	Formula Weight.	Empirical Formula.
1	Phenyl oxydisulphide	$(C_6H_5)_2S_2O_2$	250.26	$C_{12}H_{10}O_2S_2$
2	— phosphine	$C_6H_5.PH_2$	110.13	C_6H_7P
3	— phosphinic acid	$C_6H_5.PO(OH)_2$	158.13	$C_6H_7O_3P$
4	— propiolic acid, *a*	$C_9H_6O_2$	146.09	$C_9H_6O_2$
5	— propyl alcohol, *a*	$C_6H_5.CH_2.CH_2.CH_2OH$	136.14	$C_9H_{12}O$
6	— — —, *β*	$C_6H_5.CH_2CHOH.CH_3$	136.14	„
7	— — —, *γ*	$C_6H_5.CHOH.CH_2.CH_3$	136.14	„
8	— — glycollic acid	$C_3H_7.C_6H_4.CHOH.COOH$	194.17	$C_{11}H_{14}O_3$
9	— — ketone	$C_6H_5.CO.C_3H_7$	136.14	$C_9H_{12}O$
10	— pyridine, *a*	$C_5H_4N.C_6H_5$	155.14	$C_{11}H_9N$
11	— —, *β*	„ „	155.14	
12	— —, *γ*	„ „	155.14	„
13	— quinoline, 2	$C_9H_6N.C_6H_5$	205.17	$C_{15}H_{11}N$
14	— —, 3	„ „	205.17	„
15	— —, 4	„ „	205.17	„
16	— —, 6	„ „	205.17	„
17	— —, 8	„ „	205.17	„
18	— salicylic acid	$C_6H_4(OC_6H_5)COOH$	214.15	$C_{13}H_{10}O_3$
19	— sulphide	$(C_6H_5)_2S$	186.20	$C_{12}H_{10}S$
20	— thiocyanate, *iso.*	C_6H_5NCS	135.15	C_7H_5NS
21	— thiourea	$CS(NH_2)NH.C_6H_5$	152.18	$C_7H_8N_2S$
22	— tolyl	$C_6H_5.C_6H_4.CH_3$	168.16	$C_{13}H_{12}$
23	— — ketone, *o*	$C_6H_5.CO.C_6H_4.CH_3$	196.17	$C_{14}H_{12}O$
24	— — —, *m*	„ „	196.17	„
25	— — —, *p*	„ „	196.17	„
26	— urethane, see	Ethyl phenyl carbaminate		
27	Phenylene diacetic acid, *o*	$C_6H_4:(CH_2.COOH)_2$	194.13	$C_{10}H_{10}O_4$
28	— — —, *m*	„ „	194.13	„
29	— — —, *p*	„ „	194.13	„
30	— diamine, *o*	$C_6H_4(NH_2)_2$	108.11	$C_6H_8N_2$
31	— —, *m*	„	108.11	„
32	— —, *p*	„	108.11	„
33	— mercaptan, 1 : 3	$C_6H_4(SH)_2$	142.20	$C_6H_6S_2$
34	— —, 1 : 4	„	142.20	„
35	Phloretic acid	$C_6H_4OH.CH(CH_3).COOH$	166.13	$C_9H_{10}O_3$

Density $H_2O=1$.	Solubility in Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
		h.s.	s.	45		1
1.001/15°					160—161	2
1.475	23.5 : 100/	s.		158		3
	h.s. 15°	v.s.	v.s.	136—137		4
1.008/18°	s.s.	m.	m.	liq.	212	5
					214.5—215.5	6
				liq.	235	7
				158		8
0.990/15°				liq.	220—222	9
>H_2O	i.			liq.	268.5—270.5 /749mm.	10
>H_2O	i.	s.	s.	oil.	269—270 /749mm.	11
	h.s.			77—78	274—275	12
	s. C_6H_6	s.	s.	83—84	363	13
	v.s.s.	s.	s.	52		14
	s.s.	h.s.	s.	61—62		15
1.194/20°				110—111	260/77mm.	16
					283/187	17
	i.	s. $CHCl_3$		159		18
1.12	i.	s.	s.		296	19
1.135/15°	i.	s. (abs.)	s.	– 21	218.5	20
	1 : 400, c. 1 : 17, h.	5.6 : 100 /17°	s. alk.	154		21
1.015/27°				27	261—262	22
				liq.	315—316	23
1.088/17.5°	m. C_6H_6	m	m.	liq.	314—316	24
	s. C_6H_6.	s s.	s.	60	322	25
						26
	c.s.s	s.	s.	150		27
	s.	s.	s.	170		28
	h.s.	s.	s.	244		29
	h.s.	v.s.	v.s., s. $CHCl_3$	102—103	256—258	30
1.1389/15°	v.s.	v.s.	v.s.	61	282—284	31
	s.	s.	s.	140	267	32
				27	243	33
				98		34
	h.s.	s.	s.	128—129		35

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Phloretin	$C_{15}H_{14}O_5$	274.19	$C_{15}H_{14}O_5$
2 Phloridzin	$C_{21}H_{24}O_{10}.2H_2O$	472.33	$C_{21}H_{24}O_{10}$
3 Phloroglucinol, 1 : 3 :	$C_6H_3(OH)_3.2H_2O$	162.11	$C_6H_6O_3$
4 — tricarboxylic ester	$C_9H_3O_9(C_2H_5)_3$	342.22	$C_{15}H_{18}O_9$
5 — triethyl ether, 1 :3 :5	$C_6H_3(OC_2H_5)_3$	210.22	$C_{12}H_{18}O_3$
6 — — —, 1 : 2 : 3	,, ,,	210.22	,,
7 — — —, 1 : 2 : 4	,, ,,	210.22	,,
8 — trioxime	$C_6H_6(NOH)_3$	171.13	$C_6H_9O_3N_3$
9 Phlorol	$C_2H_5.C_6H_4OH$	122.12	$C_8H_{10}O$
10 Phorone	$(CH_3)_2:C:CH.CO.CH:C:(CH_3)_2$	138.16	$C_9H_{14}O$
11 Phosgene	$COCl_2$	98.93	$COCl_2$
12 Phosphenyl chloride	$C_6H_5.PCl_2$	179.03	$C_6H_5Cl_2P$
13 Phosphenylic acid	$C_6H_5.PO(OH)_2$	142.13	$C_6H_7O_2P$
14 Phospho benzene	$C_6H_5.P:P.C_6H_5$	216.22	$C_{12}H_{10}P_2$
15 Phthalanil, *sym.*	$C_8H_4O_2:N.C_6H_5$	223.15	$C_{14}H_9O_2N$
16 —, *asym.*	,, ,,	223.15	,,
17 Phthalic acid, *o*	$C_6H_4:(COOH)_2$	166.09	$C_8H_6O_4$
18 Phthalate, ethyl	$C_6H_4(COOC_2H_5)COOH$	194.13	$C_{10}H_{10}O_4$
19 Phthalic acid, *m.*, *iso.*	$C_6H_4:(COOH)_2$	166.09	$C_8H_6O_4$
20 — —, *p*, *tere.*	,, ,,	166.09	,,
21 — aldehyde	$C_6H_4:(CHO)_2$	134.09	$C_8H_6O_2$
22 — —, *iso.*	,, ,,	134.09	,,
23 — —, *tere.*	,, ,,	134.09	,,
24 — anhydride	$C_6H_4:(CO)_2:O$	148.07	$C_8H_4O_3$
25 Phthalide	$C_6H_4:(CH_2)(CO):O$	134.09	$C_8H_6O_2$
26 Phthalimide	$C_6H_4:(CO)_2:NH$	147.09	$C_3H_5O_2N$
27 Phthalonic acid	$COOH.C_6H_4.CO.COOH\ .2H_2O$	230.12	$C_9H_6O_5$
28 Phthalonitrile, *iso.*	$C_6H_4:(CN)_2$	128.09	$C_8H_4N_2$
29 — —, *tere.*	,,	128.09	,,
30 Phthalophenone	$(C_6H_5)_2:C.C_6H_4.CO.O$	286.21	$C_{20}H_{14}O_2$
31 Phthalyl chloride, *o*	$C_6H_4:(COCl)_2$	202.99	$C_8H_4O_2Cl_2$
32 — —, *m*	,, ,,	202.99	,,
33 — —, *p*	,, ,,	202.99	
34 Physetoleic acid, see	Hypogæic acid		
35 Picoline, 2-methyl	C.H.N.CH	93.10	C.H.N

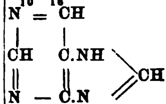
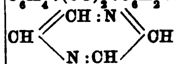
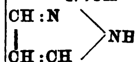
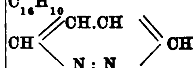
Density $H_2O=1$.	Solubility in— Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
	h.v.s.s.	h.m. acetic.	v.s.s.	253—255 d.		1
1.4298/19°	h.s.	s.	i.	108		2
	s.	s.	s.	an. 217—219		3
	i.	s.s.	s.	104		4
	i.	v.s.	v.s.	43	175/24mm.	5
				39		6
				34		7
	v.s.s.	v.s.s.	s. $CHCl_3$, acetone	d 140		8
1.0371/0°				liq.	206.5—207.5	9
0.8850/20°				28	197—200	10
1.392/18.5°	d.	d.			8	11
1.375/20°				liq.	225	12
1.475	23.5 : 100 /15°	s.	s.	158	d.	13
	i.	i., s.h. C_6H_6	i.	149—150		14
	i.	s.		208	subl.	15
				125—126		16
1.585-1.593	18 : 100/99°	1 : 10 (abs) 15°	0.684 : 100/15°	196—199 d.		17
	s.	s.		liq.	d.	18
	1 : 460, h.	s.		348.5	subl.	19
	c.v.s.s.	i.	i.		subl.	20
		s.		52		21
				89—90		22
	1 : 60, h.	v.s.	s.	116		23
1.527/4°	s.	s. CS_2		131.5	284.5	24
	h.s.	s.		75	290	25
	s. acetic.	s.	s.	228—229	subl.	26
	s.	s.	s.	144.5		27
	c.s.s.	s.	s.	160—161		28
		s.s.	s.s.	222		29
	s. H_2SO_4	s.		115		30
1.4069/20°					275.4/726	31
				41	276	32
				77—78	259	33
						34
0.9526/10°				liq.	129	35

	Name.	Formula.	Formula Weight.	Empirical Formula.
1	Picoline, 3-methyl	$C_5H_4N.CH_3$	93.10	C_6H_7N
2	—, 4-methyl	"	93.10	"
3	Picolinic acid	$C_5H_4N.COOH$	123.08	$C_6H_5O_2N$
4	Picramide, trinitro aniline	$C_6H_2(NO_2)_3NH_2$	228.10	$C_6H_4O_6N_4$
5	Picramic acid	$C_6H_2(NO_2)_2(NH_2)OH$	199.10	$C_6H_5O_5N_3$
6	Picric acid, see	Trinitro phenol		
7	Picryl chloride,1 :3 :5 :2	$C_6H_2(NO_2)_3Cl$	247.54	$C_6H_2O_6N_3Cl$
8	— —, 1 : 2 : 4 : 5	" "	247.54	"
9	Pimaric acid, *d*	$C_{20}H_{30}O_2$	302.34	$C_{20}H_{30}O_2$
10	— —, *l*	"	302.34	"
11	— —, *i*	"	302.34	"
12	Pimelic acid	$C_7H_{12}O_4$	160.13	$C_7H_{12}O_4$
13	Pinacoline	$CH_3.CO.C(CH_3)_3$	100.13	$C_6H_{12}O$
14	Pinacone	$(CH_3)_2(C.OH)_2(CH_3)_2$	118.14	$C_6H_{14}O_2$
15	Pinene, act.	$C_{10}H_{16}$	136.18	$C_{10}H_{16}$
16	— hydrochloride	$C_{10}H_{17}Cl$	172.65	$C_{10}H_{17}Cl$
17	Pinol	$C_{10}H_{16}O$	152.18	$C_{10}H_{16}O$
18	Pipecoline, methyl piperidine, *α*	$C_5H_{10}N.CH_3$	99.14	$C_6H_{13}N$
19	—, — —, *β*	"	99.14	"
20	—, — —, *γ*	"	99.14	"
21	Piperazine, see	Diethylene diamine		
22	Piperidine	$CH_2\left\langle\begin{matrix}CH_2.CH_2\\CH_2.CH_2\end{matrix}\right\rangle NH$	85.12	$C_5H_{11}N$
23	Piperinic acid	$C_{12}H_{10}O_4$	218.14	$C_{12}H_{10}O_4$
24	Piperonal	$(CH_2O_2)C_6H_3.CHO$	150.09	$C_8H_6O_3$
25	Piperonyl alcohol	$C_8H_8O_3$	152.10	$C_8H_8O_3$
26	Piperonylic acid	$C_8H_6O_4$	166.09	$C_8H_6O_4$
27	Piperylene	$CH_2:CH.CH_2.CH:CH_2$	68.09	C_5H_8
28	Pivalic acid	$(CH_3)_3C.COOH$	102.11	$C_5H_{10}O_2$
29	Populin, benzoyl salicin	$C_{20}H_{22}O_8.2H_2O$	426.31	$C_{20}H_{22}O_8$
30	Prehnitic acid,1 :2 :3 :5	$C_6H_2(COOH)_4$	254.10	$C_{10}H_6O_8$
31	Prehnitole, 1 :2 :3 :4	$C_6H_2(CH_3)_4$	134.16	$C_{10}H_{14}$
32	Propane	C_3H_8	44.08	C_3H_8
33	Propiolic acid	$CH:C.COOH$	70.03	$C_3H_2O_2$

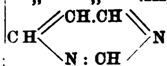
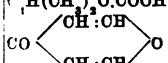
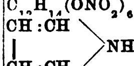
Density H_2O=1.	Solubility in Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
0.9726/0°	m.			liq.	144—147	1
0.9742/0°				liq.	142.5—144.5	2
	s.	s.	i.	134.5—136		3
	i.	i.	s. acetic.	188		4
	s.s.	s., s.ac.	s.s.	168—169		5
						6
	c.i., h.d.	h.s.	s.s.	83		7
				116		8
	i.	s.	s.	210—211	282/15—20	9
				140—150		10
				144—146		11
	1 : 24/20°	s.	s.	105	272/100mm.	12
0.7999/16°	v.s.s.				106	13
	h.s.	s.		35—38	171—172	14
0.865/15°	i.	s.		– 50	156.4—156.6 /757mm.	15
		i.		133.5	210	16
0.942/20°				liq.	183—184	17
0.8622/0°					116—117 /714mm.	18
0.8635/0°	v.s.			liq.	125—126	19
0.8674/0°	s.			liq.	126.5—128	20
						21
0.8615/20°	m.	s.		– 17	106/759mm.	22
	i.	1 : 50, h.	i.	216—217		23
	h.s.	s.	m.	37	263	24
	h.s.	m.	m.	51		25
	h.s.s.	h.s.	s.s.	227—229		26
				liq.	40—41	27
0.905/50°	s.			35.3—35.5	163.7—163.8	28
	1 : 42/100°	v.s.		180		29
	s.			237—250		30
				– 4	204	31
0.613/—25°		6 : 1 vol.		– 195	–38	32
	s.	s.	s.	6	140—145, d. 154	33

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Propiolic alcohol	$CH:C.CH_2OH$	56.05	C_3H_4O
2 Propionamide	$C_2H_5.CO.NH_2$	73.08	C_3H_7ON
3 Propionic acid	$C_2H_5.COOH$	74.06	$C_3H_6O_2$
4 Propionate, amyl	$C_2H_5.COO.C_5H_{11}$	144.17	$C_8H_{16}O_2$
5 —, ethyl	$C_2H_5.COO.C_2H_5$	102.11	$C_5H_{10}O_2$
6 Propionic anhydride	$(C_2H_5.CO)_2:O$	130.11	$C_6H_{10}O_3$
7 Propionitrile	$C_2H_5.CN$	55.07	C_3H_5N
8 Propionyl formic acid,	see Keto-butyric acid		
9 Propyl alcohol, norm.	$CH_3.CH_2.CH_2OH$	60.08	C_3H_8O
10 — —, *iso.*	$CH_3.CHOH.CH_3$	60.08	,,
11 — aldehyde	$CH_3.CH_2.CHO$	58.06	C_3H_6O
12 — amine, norm.	$C_2H_5.CH_2.NH_2$	59.10	C_3H_9N
13 — —, *iso.*	$(CH_3)_2:CH.NH_2$	59.10	,,
14 — benzene, norm.	$C_6H_5.C_3H_7$	120.14	C_9H_{12}
15 — —, cumene	$C_6H_5.CH:(CH_3)_2$	120.14	,,
16 — carbylamine, *iso.*	$(CH_3)_2:CH.NC$	69.09	C_4H_7N
17 — chloride, norm.	C_3H_7Cl	78.53	C_3H_7Cl
18 — —, sec.	$(CH_3)_2:CHCl$	78.53	,,
19 — cyanide, norm.	C_3H_7CN	69.09	C_4H_7N
20 — —, sec.	$(CH_3)_2:CH.CN$	69.09	,,
21 — mercaptan	$C_3H_7.SH$	76.14	C_3H_8S
22 — nitrolic acid	$CH_3.CH_2.C(NO_2)NOH$	118.08	$C_3H_6O_3N_2$
23 — pyridine, *a*	$C_3H_7.C_5H_4N$	121.14	$C_8H_{11}N$
24 — —, *a iso.*	,, ,,	121.14	,,
25 — —, *γ iso.*	,, ,,	121.14	,,
26 — sulphide	$(C_3H_7)_2:S$	118.20	$C_6H_{14}S$
27 — thiocyanate, *iso.*	$C_3H_7.NCS$	101.15	C_4H_7NS
28 Propylene	$CH_3.CH:CH_2$	42.06	C_3H_6
29 — bromide	$CH_3.CHBr.CH_2Br$	210.90	$C_3H_6Br_2$
30 — ether	C_3H_6O	58.06	C_3H_6O
31 — glycol, tri-methylene alcohol	$CH_2OH.CH_2.CH_2OH$	76.08	$C_3H_8O_2$
32 — —, propylene alcohol	$CH_3.CHOH.CH_2OH$	76.08	,,
33 Protocatechuic acid,	see Dihydroxy benzoic acid		
34 — aldehyde, 1 : 3 : 4	$C_6H_3(OH)_2CHO$	138.08	$C_7H_6O_3$
35 Pseudo cumene, 1 : 2 : 4	$C_6H_3(CH_3)_3$	120.14	C_9H_{12}
36 — cumidine, 1 : 2 : 4 : 5	$(CH_3)_3C_6H_2.NH_2$	135.16	$C_9H_{13}N$
37 — morphine	$C_{34}H_{36}N_2O_6.3H_2O$	622.53	$C_{34}H_{36}O_6N_2$
38 — tropine	$C_8H_{15}NO$	141.17	$C_8H_{15}ON$

Density H_2O=1.	Solubility in Water.	Solubility in Alcohol.	Solubility in Ether.	M.P. °C.	B.P. °C.	
0.9628/21°	s.			– 17	114—115	1
1.0335		s.	s.	80	213	2
0.9871/19.9°	m.	s.	s.	– 19.3	140.5	3
0.887/0°				liq.	160.2	4
0.8964/16°		s.		– 72.6	99.1	5
1.0169/15°	i.			liq.	165.8	6
0.801/0°	s.			– 103.5	98	7
						8
0.8066/15°	s.	s.	s.	liq.	97.2	9
0.7887/20°	s.	s.	s.	liq.	82.7	10
0.8066/20°	1 : 5/20°				49.5/740	11
0.7168/20°	s.			liq.	49	12
0.690/18°	m.			liq.	32—32.5	13
0.881/0°	i.	s.	s.		157—158	14
0.8798/0°	i.	s.	s.	– 75.1	152.5—153.5	15
				liq.	87	16
0.891/18°					44/744mm.	17
0.8588/20°					37	18
0.795/12.5°				liq.	118.5	19
				liq.	107—108	20
	v.s.s.				67	21
	v.s.	s.	v.s.	74—75		22
$<H_2O$				liq.	165—168	23
0.9342/0°	s.s.				158—159	24
0.9439/0°					177—178	25
0.814/17°				liq.	141.5—142.5	26
					137—137.5	27
1.498		12 : 1 vol.			– 37	28
1.9463/17°					130	29
	s.	s.	s.	liq.	35	30
1.0526/18°	m.	m.	1 : 12.5 vol.	liq.	216	31
1.051/0°	m.			liq.	188—189	32
						33
	1 : 20, c.	v.s.	v.s.	153—154		34
0.8810/15°					167—167.6	35
				64	234—235	36
	s. KOH	i.	i.	d. 245		37
	v.s.	v.s.	s.s., CHCl	108	241—243	38

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Pulegone	$C_{10}H_{16}O$	152.18	$C_{10}H_{16}O$
2 Purine		120.10	$C_5H_4N_4$
3 Purpurin	$C_{14}H_5O_2(OH)_3$	256.13	$C_{14}H_8O_5$
4 Purpuroxanthene, 1:3	$C_6H_4:(CO)_2:C_6H_2:(OH)_2$	240.13	$C_{14}H_8O_4$
5 Pyrazine		80.07	$C_4H_4N_2$
6 Pyrazole		68.07	$C_3H_4N_2$
7 Pyrazoline	$CH_2.CH_2.CH:N.NH$	70.08	$C_3H_6N_2$
8 Pyrazolone	$CO.CH_2.CH:N.NH$	84.07	$C_3H_4ON_2$
9 Pyrene	$C_{16}H_{10}$	202.16	$C_{16}H_{10}$
10 Pyridazine		80.07	$C_4H_4N_2$
11 Pyridine	C_5H_5N	79.08	C_5H_5N
12 — carboxylic acid, 1:2	see Picolinic acid		
13 — — —, 1:3	see Nicotinic acid		
14 — — —, 1:4, *iso*-nicotinic acid	$C_5H_4N.COOH$	123.08	$C_6H_5O_2N$
15 — dicarboxylic acid, 1:3:4, cinchomeronic acid	$C_5H_3N:(COOH)_2$	167.09	$C_7H_5O_4N$
16 — — —, 1:2:5, iso-cinchomeronic acid	„ „ (½ or 1½ H_2O)	167.09	„
17 — — —, 1:2:6, dipicolinic acid	„ „ (1½ H_2O)	167.09	„
18 — — —, 1:3:5, dinicotinic acid	„ „	167.09	„
19 — — —, 1:2:4, lutidinic acid	„ „ (H_2O)	167.09	„
20 — — —, 1:2:3, quinolic acid	„ „	167.09	„
21 — penta carboxylic acid	$C_5N(COOH)_5$ (2—3H_2O)	299.10	$C_{10}H_5O_{10}N$

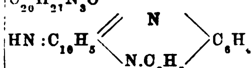
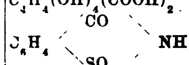
Density $H_2O=1$.	Solubility in Water.	Alcohol.	Ether	M.P. °C.	B.P. °C.	
0.932/20°				liq.	221.2	1
	v.s.	s.	s. toluene	211—212		2
	s., s. CS_2	s.	s.	256	subl. 150	3
	s. C_6H_6	s.	s. acetic	262—263	subl.	4
	s.	s.	s., s. ac.	47	118/768.4	5
	c.s.	s.	s.	69	186—188	6
	m.	m.	s.s.	liq.	144	7
	s.	v.s.	v.s.s.	165		8
	v.s. CS_2	1.37 : 100/16°	v.s.	147	>360	9
1.1070/20°	m.	s.	s., s. ac.	– 8	208	10
0.9893/15°	m.			– 42	115.5	11
						12
						13
	s.s.	s.s. C_6H_6	v.s.s.	299 under pressure		14
	h.v.s.s.	s.s.	i.	258—259		15
	h.s.	i.	i.	236		16
	h.s.	v.s.		226		17
	v.s.s.			323		18
	h.v.s.	h.v.s.	i.	237		19
	1 : 183/65°	s.s.	v.s.s.	190—195		20
	v.s.		v.s.s.	d. 220		21

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Pyridine tricarboxylic acid, 1 : 2 : 3 : 4	$C_5H_2N(COOH)_3.1\frac{1}{2}H_2O$	238.12	$C_8H_5O_6N$
2 — — —, 1 : 2 : 4 : 5	,, ,, $.2H_2O$	247.12	,,
3 — — —, 1 : 3 : 4 : 5	,, ,, $.3H_2O$	265.14	,,
4 — — —, 1 : 2 : 4 : 6	,, ,, $.2H_2O$	247.12	,,
5 — — —, 1 : 2 : 3 : 5	,, ,, $.2H_2O$	247.12	,,
6 — — —, 1 : 2 : 3 : 6	,, ,, $.2H_2O$	247.12	,,
7 Pyrimidine		80.07	$C_4H_4N_2$
8 Pyrocatechol, see	Dihydroxy benzene		
9 Pyrogallol, 1 : 2 : 3	$C_6H_3(OH)_3$	126.08	$C_6H_6O_3$
10 — carboxylic acid, 1 : 2 : 3 : 4	$C_6H_2(OH)_3COOH.\frac{1}{3}H_2O$	176.09	$C_7H_6O_5$
11 —dimethyl ether, 2 : 1 : 3	$C_6H_3(OH)(OCH_3)_2$	154.12	$C_8H_{10}O_3$
12 Pyro mellitic acid, 1 : 2 : 4 : 5	$C_6H_2(COOH)_4.H_2O$	272.12	$C_{10}H_6O_8$
13 — mucic acid	$C_4H_3O.COOH$	112.16	$C_5H_4O_3$
14 — — —, *iso.*	,, ,, $.2H_2O$	148.09	,,
15 — racemic acid	$CH_3.CO.COOH$	88.05	$C_3H_4O_3$
16 — tartaric acid, glutaric acid	$(CH_2)_3(COOH)_2$	132.09	$C_5H_8O_4$
17 — — —, methyl succinic acid	$CH_3.CH(COOH)_2CH_2$	132.09	,,
18 — — —, ethyl malonic acid	$C_2H_5.CH:(COOH)_2.H_2O$	150.11	,,
19 — — —, dimethyl malonic acid	$(CH_3)_2:C:(COOH)_2$	132.09	,,
20 — — — anhydride	$C_3H_6:(CO)_2:O$	114.07	$C_5H_6O_3$
21 — terebic acid	$C_5H_9.COOH$	114.11	$C_6H_{10}O_2$
22 — tritartaric acid	$C_4H(CH_3)_2O.COOH$	140.10	$C_7H_8O_3$
23 Pyrone, γ		96.06	$C_5H_4O_2$
24 — α-carboxylic acid	$C_5H_3O_2.COOH$	140.06	$C_6H_4O_4$
25 Pyroxylin	$C_{12}H_{14}(ONO_2)_6O_4$	594.23	$C_{12}H_{14}O_{22}N_6$
26 Pyrrole		67.07	C_4H_5N
27 — α-carboxylic acid	$C_4H_4N.COOH$	118.08	$C_5H_5O_2N$

Density $H_2O=1$.	Solubility in Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
	1 : 83.9 /15°	s.s.	v.s.s.	249—250		1
	h.s.	h.v.s.s.	i.	235		2
	h.s.			261 d.		3
	s.		s.s.	227 d.		4
	s.s.	s.		323		5
	v.s.		i.	> 100	d. 130	6
	s.	s.		20—22	123.5—124 /762mm.	7
						8
1.463/40°	44 : 100 /13°	s.	s.	132	292—294 /730mm.	9
	v.s.	s.	s.	195—200	subl.	10
	s.			52	252	11
	14.2 : 100 /16°	v.s.		275		12
	1 : 28/15°	s.	s.	131—132	subl.	13
	s.	v.s.	s.	87	102/15mm.	14
1.288/18°	m.	m.	m.	13.6	165	15
	1 : 1.2/14°	v.s.	v.s.	97.5	302—304	16
1.410	1 :1.5/20°	v.s.	v.s.	112	d.	17
	s.	s.	s.	an. 111.5	d.	18
	1 : 10/13°	s.s.	v.s.	117	subl. 120	19
1.2378/15°	s.s.	s.		37	247.4	20
1.006/26°	s.	s.	s.	46	207	21
						22
	v.s.			32.5	210—215	23
	s.s.			d.250		24
	s.s. acetone	i.	i.	expl.		25
0.9481/20°	i.	v.s.	v.s.	liq.	126.2	26
	s.	s.	s.	d. 191.5		27

	Name.	Formula.	Formula Weight.	Empirical Formula.
1	Pyrrolidine	$(CH_2)_4 : NH$	71.10	C_4H_9N
2	Pyrroline	$CH.CH_2$ ‖ $CH.CH_2$ > NH	69.09	C_4H_7N
3	Quercetin	$(OH)_2 \cdot\cdot C_6H_2$ < $O.C.C_6H_3(OH)_2$ ‖ $OC.C(OH)$	302.16	$C_{15}H_{10}O_7$
4	Quercite	$C_6H_{12}O_5$	164.13	$C_6H_{12}O_5$
5	Quercitrin	$C_{21}H_{22}O_{12}.2H_2O$	502.31	$C_{21}H_{22}O_{12}$
6	Quinaldine	$C_9H_6N.CH_3$	143.13	$C_{10}H_9N$
7	Quinazine, see	Quinoxaline		
8	Quinazolone	C_6H_4 < $CH : N$ | $N : CH$	130.11	$C_8H_6N_2$
9	Quinhydrone	$C_{12}H_{10}O_4$	218.14	$C_{12}H_{10}O_4$
10	Quinic acid	$C_6H_7(OH)_4COOH$	192.13	$C_7H_{12}O_6$
11	Quininic acid	$C_{11}H_9O_3N$	203.14	$C_{11}H_9O_3N$
12	Quinitol, cis. 1 : 2	$C_6H_4:(OH)_2(H_6)$	116.13	$C_6H_{12}O_2$
13	—, trans. 1 : 2	„ „	116.13	„
14	—, cis. 1 : 3	„ „	116.13	„
15	—, cis. 1 : 4	„ „	116.13	„
16	—, trans. 1 : 4	„ „	116.13	„
17	—, isom. 1 : 4	„ „	116.13	„
18	Quinizarin	$C_6H_4:(CO)_2:C_6H_2:(OH)_2$	240.13	$C_{14}H_8O_4$
19	Quinolic acid, see	Pyridine dicarboxylic acid		
20	Quinoline	C_6H_4 < $CH : CH$ | $N : CH$	129.11	C_9H_7N
21	—, *iso.*	C_9H_7N	129.11	„
22	Quinolinic acid, 1 : 2 : 3	$C_5H_3N(COOH)_2$	167.09	$C_7H_5O_4N$
23	Quinone, 1 : 4	$C_6H_4O_2$	108.06	$C_6H_4O_2$
24	— chlorimide	$O.C_6H_4.N.Cl$	141.53	C_6H_4ONCl
25	— dichlorimide	$C_6H_4(:N.Cl)_2$	175.00	$C_6H_4N_2Cl_2$
26	— dioxime	$C_6H_4(:NOH)_2$	138.10	$C_6H_6O_2N_2$
27	—, tetra-hydro	$C_6H_4O_2(H_4)$	112.09	$C_6H_8O_2$
28	Quinoxaline	C_6H_4 < $N : CH$ | $N : CH$	130.11	$C_8H_6N_2$
29	Raffinose	$C_{18}H_{32}O_{16}.5H_2O$	594.43	$C_{18}H_{32}O_{16}$
30	Resorcinol, see	Dihydroxy benzene		

Density $H_2O=1$.	Solubility in Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
0.879/0°	m.			liq.	87.5—88.5	1
0.852/22.5°						
0.9027/20°	v.s.			liq.	90—91	2
1.5845/1[illegible]	h.s.s.	1 : 18.2, h.	v.s.s.	310—312		3
	s.	h.s	i.	225	d.	4
	h.s.s.	h.s.	s.s.			5
1.0646/20°		s.			246—247	6
						7
				48—48.5	243/772mm.	8
	h.s.	s.	s.	171	subl.	9
	1 : 2.5/9°	v.s.s.	v.s.s.	162	d.	10
	s.s.	s.s.	v.s.s.	d. 280		11
	s.	s.	v.s.s.	75—76	225	12
				99—100	225	13
				65		14
				102		15
				140		16
					218—225	17
	s. KOH	s.	s., s. C_6H_6	194—195	subl.	18
						19
1.0944/20°		s.	s. CS_2	– 19.5	238	20
1.0986/20°		s.	s.	– 24.6	240/750mm.	21
	6.5 : 183	s.s.	v.s.s.	190—195	d.	22
1.307-1.318	h.s.	s.	s.	115.7	subl.	23
	h.s.	s.	h.s.	84.7—85	d.	24
	h.s.s.	h.s.	v.s.	d. 124		25
	s. conc. NH_3				d. 240	26
		v.s.	v.s.	78		27
	m.	m.	m.	27	225—226	28
	1 : 7/20°,	v.s.s.		an. 118—119		29
	h.m.					30

	Name.	Formula.	Formula Weight.	Empirical Formula.
1	Resorcinol methyl ether	$OH.C_6H_4.OCH_3$	124.10	$C_7H_8O_2$
2	Resorcylic acid, 3 :5 :1	$C_6H_3(OH)_2COOH$ ($1\frac{1}{2}H_2O$)	154.08	$C_7H_6O_4$
3	— —, 2 :4 :1	,, ,, ($3H_2O$)	154.08	,,
4	Retene	$C_{18}H_{18}$	234.23	$C_{18}H_{18}$
5	Rhamnite	$CH_3.(CHOH)_4.CH_2OH$	166.14	$C_6H_{14}O_5$
6	Rhamnose	$CH_3(CHOH)_4CHO.H_2O$	182.15	$C_6H_{12}O_5$
7	Rhodizonic acid	$C_6(OH)_2O_4$	170.05	$C_6H_2O_6$
8	Ricinoleic acid	$C_{18}H_{34}O_3$	298.36	$C_{18}H_{34}O_3$
9	Roccellic acid	$C_{15}H_{30}(COOH)_2$	300.34	$C_{17}H_{32}O_4$
10	Rosaniline	$C_{20}H_{21}N_3O$	319.24	$C_{20}H_{21}ON_3$
11	Rosinduline		321.26	$C_{22}H_{15}N_3$
12	Rosolic acid	$C_{20}H_{16}O_3$	304.23	$C_{20}H_{16}O_3$
13	Rubeanhydride	$NH_2.CS.CS.NH_2$	120.18	$C_2H_4N_2S_2$
14	Ruberythric acid	$C_{26}H_{28}O_{14}$	564.35	$C_{26}H_{28}O_{14}$
15	Rufigallic acid	$C_{14}H_8O_8.2H_2O$	340.16	$C_{14}H_8O_8$
16	Rufiopin	$C_{14}H_8O_6$	273.13	$C_{14}H_8O_6$
17	Rufol, see	Dihydroxy anthracene		
18	Saccharic acid	$C_4H_4(OH)_4(COOH)_2$	210.11	$C_6H_{10}O_8$
19	Saccharin		183.15	$C_7H_5O_3NS$
20	Safrol	$CH_2:O_2:C_6H_3.CH_2.CH:CH_2$	162.13	$C_{10}H_{10}O_2$
21	—, *iso.*	$CH_2:O_2:C_6H_3.CH:CH.CH_3$	162.13	,,
22	Salicin	$C_{13}H_{18}O_7$	286.21	$C_{13}H_{18}O_7$
23	Salicyl aldehyde, see	Hydroxy benzaldehyde		
24	— amide	$C_6H_4.OH.CONH_2$	137.10	$C_7H_7O_2N$
25	— anilide	$C_6H_4OH.CONH.C_6H_5$	213.16	$C_{13}H_{11}O_2N$
26	Salicylic acid, *o*	$C_6H_4OH.COOH$	138.08	$C_7H_6O_3$
27	— —, *m*	,, ,,	138.08	,,
28	— —, *p*	,, ,, ($.H_2O$)	138.08	,,
29	Salicylate, ethyl	$C_6H_4OH.COO.C_2H_5$	166.13	$C_9H_{10}O_3$
30	—, methyl	$C_6H_4OH.COO.CH_3$	152.10	$C_8H_8O_3$
31	—, phenyl	$C_6H_4OH.COO.C_6H_5$	214.15	$C_{13}H_{10}O_3$
32	Salicylic anhydride	$(C_6H_4)_2O_3(CO)_2$	240.13	$C_{14}H_8O_4$

Density H_2O=1.	Solubility in Water.	Solubility in Alcohol.	Solubility in Ether.	M.P. °C.	B.P. °C.	
	s.s.	s.s.	s.s.	liq.	243—244	1
	h.v.s.	s.	s.	232—233		2
	1 : 381/17°	s.	s.	213		3
1.13/16°		69 : 100/78°	v.s.	98	390	4
	v.s.	v.s.	s.s. $CHCl_3$	121		5
1.4708/20°	60 : 100/20°	s.		92—93, an. 122—126		6
	s.	i.		d.		7
		m.	m.	16—17	250/15mm.	8
	i.	s.	s.	132		9
	s.s.	s.	i.			10
	i.	s.	s.	198—199		11
	v.s.s.	h.v.s.	s.	d.		12
	v.s.s.	v.s.	v.s.			13
	h.s.	s.s.	s.s.	258—260		14
	h.s.s	s.s	s.s.	subl.		15
	h.s.s.	s.	s.s.	subl.	d,	16
						17
	v.s.	s.	s.s.			18
	0.43 : 100/25°	v.s.	v.s. xylene	220 d.		19
1.114/0°	i.	s.		8	233	20
(liq.)	i.	s.			251	21
1.426—1.434/26°	1 : 28/15°	s.	i.	201	d.	22
						23
	s.s.		m.	142	subl.	24
	h.s.s.	s.	s.	134—135		25
1.4835/4°	8 : 100/100°	1 : 2/15°	1 : 2/15°	156.5		26
1.473/4°	0.843 : 100/18.8°		s.	199.8		27
1.468/4°	0.492 : 100/209°	s.	s.	215	d.	28
1.1843/20°				1.3	231.5	29
1.182/16°	s.s.	s.		– 8.3	224	30
		h.v.s.	s.	42	173/12mm.	31
	i.	s.	s.	200—201	d.	32

Name.	Formula.	Formula Weight.	Empirical Formula.
1 **Saligenin**	$C_6H_4OH.CH_2OH$	124.10	$C_7H_8O_2$
2 **Santalic acid**	$C_{15}H_{14}O_5$	274.19	$C_{15}H_{14}O_5$
3 **Santonin**	$C_{15}H_{18}O_3$	246.22	$C_{15}H_{18}O_3$
4 **Sarcosine**	$NH.CH_3.CH_2.COOH$	89.08	$C_3H_7O_2N$
5 **Sebacic acid**	$C_8H_{16}(COOH)_2$	202.19	$C_{10}H_{18}O_4$
6 **Selenium di-ethyl**	$(C_2H_5)_2Se$	137.3	$C_4H_{10}Se$
7 **— di-methyl**	$(CH_3)_2Se$	109.3	C_2H_6Se
8 **Semicarbazide**	$NH_2.CO.NH.NH_2$	75.08	CH_5ON_3
9 **Serin**	$C_2H_3(OH)(NH_2)COOH$	105.08	$C_3H_7O_3N$
10 **Silico-acetic acid**	$CH_3.SiOOH$	76.3	CH_4O_2Si
11 **— benzoic acid**	$C_6H_5.SiOOH$	138.3	$C_6H_6O_2Si$
12 **— heptane**	$(C_2H_5)_3SiH$	116.5	$C_6H_{16}Si$
13 **Silicon phenyl trichloride**	$C_6H_5.SiCl_3$	211.8	$C_6H_5Cl_3Si$
14 **— — tri-ethyl**	$C_6H_5.Si(C_2H_5)_3$	192.5	$C_{12}H_{20}Si$
15 **— tetra-ethyl**	$(C_2H_5)_4Si$	144.15	$C_8H_{20}Si$
16 **— — methyl**	$(CH_3)_4Si$	88.4	$C_4H_{12}Si$
17 **Skatol**	$C_8H_6N.CH_3$	131.13	C_9H_9N
18 **Sorbic acid**	$C_5H_7.COOH$	112.09	$C_6H_9O_2$
19 **Sorbite**	$C_6H_{14}O_6.\frac{1}{2}H_2O$	191.15	$C_6H_{14}O_6$
20 **Sorbose**	$C_6H_{12}O_6$	180.13	$C_6H_{12}O_6$
21 **Stearic acid**	$C_{17}H_{35}.COOH$	284.38	$C_{18}H_{36}O_2$
22 **Stearin**	$C_3H_5(C_{18}H_{35}O_2)_3$	891.17	$C_{57}H_{110}O_6$
23 **Stearolic acid**	$C_{17}H_{31}.COOH$	280.35	$C_{18}H_{32}O_2$
24 **Stearone**	$C_{35}H_{70}O$	506.74	$C_{35}H_{70}O$
25 **Stearoxylic acid**	$C_{18}H_{32}O_4$	312.35	$C_{18}H_{32}O_4$
26 **Stilbene**	$C_6H_5.CH:CH.C_6H_5$	180.17	$C_{14}H_{12}$
27 **Styracine**	$C_8H_7.COO.C_9H_9$	264.22	$C_{18}H_{16}O_2$
28 **Styroline**	$C_6H_5.CH:CH_2$	104.10	C_8H_8
29 **Suberane, see**	Hepta methylene		
30 **Suberic acid**	$C_6H_{12}(COOH)_2$	174.15	$C_8H_{14}O_4$
31 **Suberone, see**	Keto-hepta methylene		
32 **Succinamide**	$C_2H_4:(CONH_2)_2$	116.10	$C_4H_8O_2N_2$
33 **Succinic acid**	$C_2H_4:(COOH)_2$	118.07	$C_4H_6O_4$
34 **— —, *iso.***	$CH_3.CH:(COOH)_2$	118.07	,,
35 **Succinate, calcium**	$C_4H_4O_4Ca$	156.12	$C_4H_4O_4Ca$
36 **—, ferrous, basic**	$(C_4H_4O_4)FeOH$	188.90	$C_4H_5O_5Fe$
37 **—, ethyl**	$C_2H_4:(COOC_2H_5)_2$	174.15	$C_8H_{14}O_4$

Density H_2O=1.	Solubility in— Water.	Alcoh.	Ether.	M.P. °C.	B.P. °C.	
1.1613/25°	1 : 15/22°, h.m.	v.s.	v.s.	86	subl.	1
	s.	s.	v.s. s. C_6H_6	104		2
1.1866	v.s.s.	s.	s., s. $CHCl_3$	169—170	subl. d.	3
	s.s.	s.s.		210—215		4
	h.s.s.	s.	s.	133—133.5	294.5/100	5
>H_2O	1 : 50/100°		v.s.	liq.	108	6
>H_2O				liq.	58.2	7
	s.	s. C_6H_6	s. $CHCl_3$	96		8
	1 : 24/20°	i.	i.	246 d.		9
	i.					10
	i.		s.	92		11
0.751/0°			s.	liq.	107	12
	d.	d.		liq.	197	13
0.9042/0°	i.		s.	liq.	230	14
0.8341/0°	i.		s.		153	15
<H_2O				liq.	26—27	16
	s.s.	s.	i.	95	265—266 /755mm.	17
	h.s.	s.	s.	134.5	228 d.	18
	s.	h.s.		110—111		19
1.654/15°	v.s.	h.s.s.		154		20
0.8521/69.5°	i.	h.s.		69.3	291/100mm.	21
0.9425/65.5°	i.	h.s.	s.	71.2		22
	i.	h.s.	s.	48	260	23
0.7979	i.	h.s.s.	s.s.	87.8		24
	i.	h.s.	s.s.	86		25
0.9707/119°		h.s.	s.	124—125	306—307	26
	i.	s.	s., s. $CHCl_3$	44		27
0.9074/20°	i.	m.	s.	liq.	145—146	28
						29
	h.s.	s.	v.s.s.	140	300	30
						31
	h.s.	i.	i.	90		32
1.552	120 : 100, h.	7 : 100	s.s.	184—185	235	33
1.455	1 : 1.5/15°	s.	s.	130 d.		34
	s.s.		i.			35
	s.s.		i. acetic.	d 180		36
.0465/15°	i.			– 20.8	216.5	37

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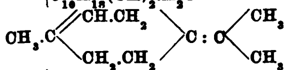
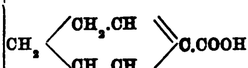
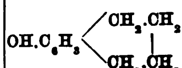
Name.	Formula.	Formula Weight.	Empirical Formula.
1 Succinate, methyl	$C_2H_4:(COOCH_3)_2$	146.11	$C_6H_{10}O_4$
2 Succinic anhydride	$C_2H_4:(CO)_2:O$	100.05	$C_4H_4O_3$
3 — aldehyde, α	$C_2H_4:(CHO)_2$	86.07	$C_4H_6O_2$
4 — —, β	" "	86.07	"
5 — —, γ	" "	86.07	"
6 — —, δ	" "	86.07	"
7 — —, ε	" "	86.07	"
8 Succinimide	$C_2H_4:(CO)_2:NH.H_2O$	117.09	$C_4H_5O_2N$
9 Succinyl chloride	$C_2H_4:(COCl)_2$	154.97	$C_4H_4O_2Cl_2$
10 Sucrose, see	Cane sugar		
11 Sulphanilic acid, see	Amino benzene sulphonic acid		
12 Sulpho acetic acid	$CH_2(SO_3H)COOH.1\frac{1}{2}H_2O$	167.13	$C_2H_4O_5S$
13 Sulphonal	$(CH_3)_2:C:(SO_2.C_2H_5)_2$	228.28	$C_7H_{16}O_4S_2$
14 Sylvan, see	Methyl furfurane		
15 Sylvestrine	$C_{10}H_{16}$	136.18	$C_{10}H_{16}$
16 Tannic acid	$C_{14}H_{10}O_9$	322.15	$C_{14}H_{10}O_9$
17 Tartaric acid, dextro	$COOH.(CHOH)_2.COOH$	150.07	$C_4H_6O_6$
18 — —, laevo	" "	150.07	"
19 — —, racemic	" " $.H_2O$	168.09	"
20 —, meso.	" " $.H_2O$	168.09	"
21 Tartrate, potassium	$C_4H_4O_6K_2(\frac{1}{2}H_2O)$	226.25	$C_4H_4O_6K$
22 —, —, acid	$C_4H_5O_6K$	188.16	$C_4H_5O_6K$
23, —, — antimonyl	$C_4H_4O_6K.SbO(\frac{1}{2}H_2O)$	323.35	$C_4H_4O_7KSb$
24 —, — sodium	$C_4H_4O_6KNa(4H_2O)$	210.15	$C_4H_4O_6KNa$
25 —, calcium	$C_4H_4O_6Ca(H_2O)$	188.12	$C_4H_4O_6Ca$
26 —, di-ethyl	$C_4H_4O_6(C_2H_5)_2$	206.15	$C_8H_{14}O_6$
27 —, ethyl	$C_4H_5O_6.C_2H_5$	178.11	$C_6H_{10}O_6$
28 Tartronic acid	$CHOH:(COOH)_2.1\frac{1}{2}H_2O$	147.07	$C_3H_4O_5$
29 Taurine	$C_2H_4NH_2.SO_3H$	125.14	$C_2H_7O_3NS$
30 Taurocholic acid	$C_{26}H_{45}NO_7S$	515.56	$C_{26}H_{45}O_7NS$
31 Tellurium di-ethyl	$(C_2H_5)_2Te$	185.6	$C_4H_{10}Te$
32 — dimethyl	$(CH_3)_2Te$	157.6	C_2H_6Te
33 Teraconic acid	$(CH_3)_2:C:C(COOH)CH_2.COOH$	158.12	$C_7H_{10}O_4$
34 Terebene	$C_{10}H_{16}$	136.18	$C_{10}H_{16}$
35 Terebentylic acid	$C_8H_{10}O_2$	138.12	$C_8H_{10}O_2$
36 Terebic acid	$C_7H_{10}O_4$	158.12	$C_7H_{10}O_4$
37 Terpenylic acid	$C_8H_{12}O_4.H_2O$	190.16	$C_8H_{12}O_4$
38 Terpinene, α	$C_{10}H_{16}$	136.18	$C_{10}H_{16}$

Density $H_2O=1$.	Solubility in Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
1.1611/15°				18.5	195.2	1
	s.s.	s.	v.s.s.	119.6	261	2
	s.	s.	s.		169—170	3
					169/761mm.	4
				64		5
				130—140		6
				90—100 d.		8
	s.	s.		125—126	287—288	8
1.4123/15°				17	190	9
						10
						11
	s.			75	subl.	12
	h.s.	1 : 2, h.	s.s.	125—126	300 d.	13
						14
0.851/16°				liq.	176—177	15
	s.	s.s.	v.s.s.			16
1.76	139 : 100/20°	1 : 5	i.	168—170		17
1.76	189 : 100/20°	s.	i.	169—170		18
1.78 an.	20.6 : 100/20°	s.s.		205		19
1.67	v.s.			140		20
1.975	s.	s.s.		an. 180		21
1.956	h.s.	s.s.				22
3.6	v.s.	i.				23
1.77	s.s.		s. ac., alk			24
	v.s.s.	i.		an. 100	d. 200	25
1.2059/20°	i.	s.	s.	liq.		26
				90		27
		s.	s.	subl. 110—120	d. 186	28
	h.s.	i.	i.	d. 240		29
	s.	s.	s.s.	180		30
				liq.	137—138	31
	i.			liq.	82	32
	s.	s.	s.	161—163 d.		33
.876/0°				liq.	160	34
	h.s.	s.	s.	90	250	35
	h.s.	s.	s.	174		36
	s.	s.	s.	an. 90	d.	37
					176/751mm.	38

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Terpinene, β	$C_{10}H_{16}$	136.18	$C_{10}H_{16}$
2 Terpineol, α	$C_{10}H_{17}OH$	154.19	$C_{10}H_{18}O$
3 Terpin hydrate	$C_{10}H_{18}(OH)_2.H_2O$	190.23	$C_{10}H_{20}O_2$
4 Terpinolene		136.18	$C_{10}H_{16}$
5 Tetra-brom-benzene, 1 : 2 : 3 : 5	$C_6H_2Br_4$	393.73	$C_6H_2Br_4$
6 — — —, 1 : 2 : 4 : 5	„	393.73	„
7 — — benzoquinone, 3 : 4 : 5 : 6	$C_6Br_4O_2$	423.71	$C_6O_2Br_4$
8 — — —, 2 : 3 : 5 : 6	„	423.71	„
9 — chlor aniline, 2 : 3 : 4 : 5	$C_6HCl_4.NH_2$	230.90	$C_6H_3Cl_4N$
10 — — —, 2 : 3 : 5 : 6	„	230.90	„
11 — — benzene, 1 : 2 : 3 : 4	$C_6H_2Cl_4$	215.89	$C_6H_2Cl_4$
12 — — —, 1 : 2 : 3 : 5	„	215.89	„
13 — — —, 1 : 2 : 4 : 5	„	215.89	„
14 — — ethane, $\alpha\ \alpha\ \alpha\ \beta$	$CH_2Cl.CCl_3$	167.87	$C_2H_2Cl_4$
15 — — —, $\alpha\ \alpha\ \beta\ \beta$	$CHCl_2.CHCl_2$	167.87	„
16 — — ether	$CCl_3.CHCl.O.C_2H_5$	211.91	$C_4H_6OCl_4$
17 — — hydroquinone	$C_6Cl_4(OH)_2$	247.89	$C_6H_2O_2Cl_4$
18 Tetradecane	$C_{14}H_{30}$	198.31	$C_{14}H_{30}$
19 Tetra decylene	$C_{14}H_{28}$	196.29	$C_{14}H_{28}$
20 — ethyl ammonium hydroxide	$(C_2H_5)_4N.OH$	219.28	$C_8H_{21}ON$
21 — — benzene, 1 : 2 : 3 : 4	$C_6H_2(C_2H_5)_4$	190.25	$C_{14}H_{22}$
22 — — —, 1 : 2 : 4 : 5	„	190.25	„
23 — hydro benzene, 1 : 2 : 3 : 4	$C_6H_6.H_4$	82.11	C_6H_{10}
24 — — benzoic acid		126.12	$C_7H_{10}O_2$
25 — — naphthalene, 1 : 2 : 3 : 4	$C_{10}H_8.H_4$	132.15	$C_{10}H_{12}$
26 — — naphthol, α		148.15	$C_{10}H_{12}O$
27 — —naphthylamine,Ac.	$C_{10}H_{13}N$	147.16	$C_{10}H_{13}N$
28 — — —, Ar.	„	147.16	„

Density $H_2O=1$.	Solubility in Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
					173—174	1
0.9357/20°	i.	s.	s.	35	217.7	2
	h.s.	s.		an. 105	258	3
	h.s.	s.	s.	174	d.	4
		h.v.s.	s.	98.5	329	5
		s.		177—178		6
	i., s. C_6H_6	h.s.	s.s.	150—151		7
					300	8
		s.	s.	118		9
				90		10
		s.s.	v.s.	45—46	254	11
		h.s.		51	246	12
1.734/10°	v.s. C_6H_6	v.s.s.	s.	137—138	243—246	13
1.5825/0°					129—130	14
1.614/0°					147	15
1.438/0°				liq.	189.7	16
	i.	v.s.	v.s.	230	subl.	17
0.764/20°				5	252.5	18
0.774/15°				– 12	127/15mm.	19
	v.s.	s.		49—50		20
					254	21
					250	22
				liq.	80—81	23
1.109/20°	s.s.			29	240—243	24
0.981/12.5°				liq.	206	25
	h.s.s.	v.s.	v.s.	69	264/716mm.	26
	v.s.	s.	s.		244.5	27
1.063/16°	s.	s.	s.		275/712mm.	28

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Tetra hydro phenol, 2 : 1 : 2 : 3 : 4	$C_6H_5OH.H_4$	98.11	$C_6H_{10}O$
2 — — phthalic acid	$C_8H_6O_4.H_4$	170.12	$C_8H_{10}O_4$
3 — — quinoline, 1 : 2 : 3 : 4	$C_9H_7N.H_4$	133.14	$C_9H_{11}N$
4 — — —, *iso.*, 1 : 2 : 3 : 4	„	133.14	„
5 — iodo pyrrole, 2 : 3 : 4 : 5	$C_4NH.I_4$	570.72	C_4HNI_4
6 — methyl ammonium hydroxide	$(CH_3)_4N.OH$	91.13	$C_4H_{13}ON$
7 — — benzene, 1 : 2 : 3 : 4, prehnitol	$C_6H_2(CH_3)_4$	134.16	$C_{10}H_{14}$
8 — — —, 1 : 2 : 3 : 5, β iso-durol	„	134.16	„
9 — — —, 1 : 2 : 4 : 5, durol	„	134.16	„
10 — — diamino benzhydrol	$HO.CH[C_6H_4.N:(CH_3)_2]_2$	270.28	$C_{17}H_{22}ON_2$
11 — — — benzophenone	$CO[C_6H_4.N:(CH_3)_2]_2$	268.27	$C_{17}H_{20}ON_2$
12 — — — diphenylamine, 4 : 4′	$NH[C_6H_4.N:(CH_3)_2]_2$	255.28	$C_{16}H_{21}N_3$
13 — — — triphenyl methane	$C_6H_5.CH[C_6H_4.N:(CH_3)_2]_2$	330.35	$C_{23}H_{26}N_2$
14 — methylene diamine	$NH_2.(CH_2)_4.NH_2$	88.14	$C_4H_{12}N_2$
15 — methyl succinic acid	$C_2(CH_3)_4(COOH)_2$	174.15	$C_8H_{14}O_4$
16 — nitro diphenol, 3 : 5 : 3′ : 5′ : 4 : 4′	$[C_6H_2(NO_2)_2OH]_2$	366.15	$C_{12}H_6O_{10}N_4$
17 — — diphenylmethane, 2 : 4 : 2′ : 4′	$CH_2[C_6H_3(NO_2)_2]_2$	348.17	$C_{13}H_8O_8N_4$
18 — — methane	$C(NO_2)_4$	196.05	CO_8N_4
19 — — naphthalene, α	$C_{10}H_4(NO_2)_4$	308.12	$C_{10}H_4O_8N_4$
20 — — —, β	„ „	308.12	„
— oxyanthraquinone,			
21 Oxypurpurin	$C_{14}H_4O_2(OH)_4$	272.13	$C_{14}H_8O_6$
22 Anthrachrysone	„ „ $.2H_2O$	308.16	„
23 Rufiopin	„ „	272.13	„
24 α-Oxy anthragallol	„ „	272.13	„
25 β-Oxy anthragallol	„ „	272.13	„
26 Quinalizarin	„ „	272.13	„

Density $H_2O=1$.	Solubility in Water.	Solubility in Alcohol.	Solubility in Ether.	M.P. °C.	B.P. °C.	
	s.			liq.	166	1
	v.s.			120 in vac.		2
1.0627/15°	s.				251	3
					229—230	4
	i., s. C_6H_6	s.	v.s.	d. 140—150		5
	v.s.			d.		6
0.8816/9°				− 4	204	7
				liq.	195	8
	s. C_6H_6	s.	s.	79—80	189—191	9
		s.	s.	96		10
		s.	s.	174	>360	11
		s.	s. CS_2	119		12
	i.	s.	s.	102		13
	s.			23—24	158—160	14
	1 : 43	s.	v.s.	190—192	subl.	15
	i.	s.		225		16
		i.	i.	172		17
	i.	s.	s.	13	126 d.	18
	c.s.s.	s. $CHCl_3$	i.	259	expl.	19
		s.		200	expl.	20
						21
	v.s.s.	v.s.s.	s. acetic	> 290		22
	i.	s.	v.s.s	> 360		23
	h.s.s.	s.	s.s.	subl.	u.	24
	v.s.s.	s.	s.s.	> 360		24
	s.s.	s.	s.s.	> 380		25
	v.s.s	s.s.	i.	> 275	subl.	26

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Tétra oxy benzene, 1 : 2 : 4 : 5	$C_6H_2(OH)_4$	142.08	$C_6H_6O_4$
2 — — benzoic acid	$C_6H(OH)_4COOH$	186.08	$C_7H_6O_6$
3 — — quinone, 2 : 3 : 5 : 6	$C_6O_2(OH)_4$	172.06	$C_6H_4O_6$
4 — phenyl ethane, α α β β	$(C_6H_5)_2:CH.CH:(C_6H_5)_2$	334.31	$C_{26}H_{22}$
5 — — ethylene	$(C_6H_5)_2:C:C:(C_6H_5)_2$	332.29	$C_{26}H_{20}$
6 Tetrazole	$CH:N$ $\mid \qquad > NH$ $N : N$	70.06	CH_2N_4
7 Tetrolic acid	$C_3H_3.COOH$	84.05	$C_4H_4O_2$
8 Theobromine	$C_7H_8N_4O_2$	180.14	$C_7H_8O_2N_4$
9 Thiacetamide	$CH_3.CS.NH_2$	75.12	C_2H_5NS
10 Thiacetanilide	$CH_3.CS.NH.C_6H_5$	151.18	C_8H_9NS
11 Thiacetic acid	$CH_3.CO.SH$	76.10	C_2H_4OS
12 Thialdin	$C_6H_{13}NS_2$	163.26	$C_6H_{13}NS_2$
13 Thianthrene	$C_6H_4:S_2:C_6H_4$	216.24	$C_{12}H_8S_2$
14 Thiazole	C_3H_3NS	85.11	C_3H_3NS
15 Thio acetaldehyde	$(CH_3.CHS)_3$	180.31	$C_6H_{12}S_3$
16 — aniline	$(C_6H_4.NH_2)_2:S$	216.24	$C_{12}H_{12}N_2S$
17 — benzaldehyde, α	$C_6H_5.CHS$	122.14	C_7H_6S
18 — —, β	"	122.14	"
19 — benzoic acid	$C_6H_5.CO.SH.\frac{1}{2}H_2O$	147.15	C_7H_6OS
20 — carbamic acid	$CS(NH_2)SH$	93.16	CH_3NS_2
21 — carbamate, ethyl	$CS(NH_2)SC_2H_5$	121.20	$C_3H_7NS_2$
22 — carbanilide	$CS(NH.C_6H_5)_2$	228.24	$C_{13}H_{12}N_2S$
23 — cyanic acid	NC.S.H.	59.08	CHNS
24 — cyanate, ethyl	$NC.S.C_2H_5$	87.13	C_3H_5NS
25 — —, methyl	$NC.S.CH_3$	73.10	C_2H_3NS
26 — cyanuric acid	$(C.NSH)_3$	177.25	$C_3H_3N_3S_3$
27 — diphenyl amine, 2 : 2'	$S(C_6H_4)_2:NH$	199.20	$C_{12}H_9NS$
28 — hydroquinone	$C_6H_4(SH)_2$	142.20	$C_6H_6S_2$
29 — naphthen	$\quad / CH:CH$ $C_6H_4 < \qquad \mid$ $\quad \backslash \qquad S$	134.15	C_8H_6S
30 — oxamide	$(CS.NH_2)_2$	120.18	$C_2H_4N_2S_2$
31 — phosgene	$CS:Cl_2$	114.99	$CSCl_2$
32 — resorcinol	$C_6H_4(SH)_2$	142.20	$C_6H_6S_2$
33 — tolene	$C_4H_3.CH_3.S$	98.13	C_5H_6S
34 — urea	$CS(NH_2)_2$	76.12	CH_4N_2S

Density $H_2O=1$.	Solubility in Water.	Solubility in Alcohol.	Solubility in Ether.	M.P. °C.	B.P. °C.	
	v.s.	v.s.	s.	215—220		1
				148		2
	h.s.	v.s.	s.s.			3
1.182	h.s. C_6H_6	s.s., s. $CHCl_3$	s. acetic.	209—211	358—362	4
	s. C_6H_6	s.s. s.	s.s.	227	415—425	5
	s.	s.	s.s.	156	subl.	6
	v.s.	v.s.s.	s.	76—77	203	7
	v.s.s.	s.	v.s.s.	330	d.	8
	v.s.		s.	107.5—108.5		9
	i.	s.	s. NaOH	75	d.	10
1.074/10°	s.s.	s.	s.	liq.	93	11
1.191	s.s.	1 : 400	v.s.	43	d.	12
	i.	s.	s.	159	364—366	13
1.1998/17°		i.	s.	liq.	117	14
	i.	s.	i.	45—46	205	15
	h.s.	i.	s.	105		16
	i.	s.s.	s. C_6H_6	160	d.	17
		m.	s. acetic	225		18
	i.	s.	m.	24		19
	s.	v.s.	s.			20
	i.	s.	v.s.	42		21
1.3035/4°	v.s.s.		s.	153		22
	m.	m	s.	5	d. 200	23
1.033/6° 1.0126/9°	i.		m.	liq.	132—133 /753mm.	24
1.0693/23.8°		v.s.s.		liq.	133	25
	h.v.s.s.	s.s.	v.s.s.			26
			v.s.	180—181	371	27
				96		28
		s.		30—31	220—221	29
	v.s.s.	s.	s.	d.		30
1.5085/15°					71—74	31
				27	243	32
1.0194				18	114/738mm.	33
1.42	1 : 11	v.s.s.	v.s.s.	180		34

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Thio urethane	$NH_2.CO.S.C_2H_5$	105.14	C_3H_7ONS
2 Thionine	$C_{12}H_9N_3S$	227.22	$C_{12}H_9N_3S$
3 Thiophen	CH : CH | >S CH : CH	84.11	C_4H_4S
4 — alcohol	$C_4H_3S.CH_2OH$	114.13	C_5H_6OS
5 — aldehyde	$C_4H_3S.CHO$	112.12	C_5H_4OS
6 — carboxylic acid, 2	$C_4H_3S.COOH$	128.12	$C_5H_4O_2S$
7 — — —, 3	,,	128.12	,,
8 Thujone	$C_{10}H_{18}O$	154.19	$C_{10}H_{18}O$
9 Thymene	$C_{10}H_{16}$	136.18	$C_{10}H_{16}$
19 Thymo hydroquinone	$C_{10}H_{14}O_2$	166.16	$C_{10}H_{14}O_2$
11 Thymol, 1 : 3 : 2	$C_6H_3(CH_3)(C_3H_7)OH$	150.16	$C_{10}H_{14}O$
12 —, *iso.*, 3 : 2 : 1	,, ,,	150.16	,,
13 Thymoquinone	$C_{10}H_{12}O_2$	164.15	$C_{10}H_{12}O_2$
14 Thymotic acid	$C_6H_2(CH_3)(C_3H_7)(OH)$ COOH	194.17	$C_{11}H_{14}O_3$
15 — anhydride	$C_6H_2(CH_3)(C_3H_7)CO.O$	176.15	$C_{11}H_{12}O_2$
16 Tiglic acid	$C_5H_8O_2$	100.09	$C_5H_8O_2$
17 Tin diethyl	$Sn(C_2H_5)_2$	176.80	$C_4H_{10}Sn$
18 — tetraethyl	$Sn(C_2H_5)_4$	234.90	$C_8H_{20}Sn$
19 — tetramethyl	$Sn(CH_3)_4$	178.81	$C_4H_{12}Sn$
20 triethyl	$Sn(C_2H_5)_3$	205.85	$C_6H_{15}Sn$
21 Tolane	$C_6H_5.C : C.C_6H_5$	178.15	$C_{14}H_{10}$
22 Tolidine, 3 : 3′ : 4 : 4′	$(CH_3.C_6H_3NH_2)_2$	212.22	$C_{14}H_{16}N_2$
23 —, 2 : 2′ : 4 : 4′	,, ,,	212.22	,,
24 —, 1 : 1′ : 4 : 4″	,, ,,	212.22	,,
25 Toluene	$C_6H_5.CH_3$	92.10	C_7H_8
26 — dihydro	$C_6H_5(H_2)CH_3$	94.12	C_7H_{10}
27 — hexahydro	$C_6H_5(H_6)CH_3$	98.15	C_7H_{14}
28 — mercaptan, thiocresol, *o*	$CH_3.C_6H_4.SH$	124.16	C_7H_8S
29 — —, —, *m*	,, ,,	124.16	,,
30 — —, —, *p*	,, ,,	124.16	,,
31 Toluic acid, *o*	$CH_3.C_6H_4.COOH$	136.10	$C_8H_8O_2$
32 — —, *m*	,, ,,	136.10	,,
33 — —, *p*	,, ,,	136.10	,,

Density $H_2O=1$.	Solubility in Water.	Solubility in Alcohol.	Solubility in Ether.	M.P. °C.	B.P. °C.	
	h.s.	s.	s.	108	subl.	1
	v.s.s.	s.s.				2
1.0705/15°	i.	s.	s.H_2SO_4	− 37.1	84	3
				liq.	207	[illegible]
1.215/21°					197—198	5
	h.v.s.	v.s.	v.s.	126.5	260	6
	s.			136		7
0.9126/20°		s.	s.		210—212	8
				liq.	160—165	9
	h.s.	s.	s.	139.5	290	10
0.9941/0°	1 : 1200	s.	s.	50	232	11
				44	228—230	12
	v.s.s.	s.	s.	45.5	232	13
	h.s.s.	s.	s.	127	sub.	14
				174		15
	h.v.s.	s.	s.	64.5	198.5	16
1.654	i.	s.		liq.	d.	17
1.187/23°	i.			liq.	181/758mm.	18
1.3138/0°	i.			liq.	78	19
1.4115/0°	i.	i.		liq.	d. 270	20
		s.	s.	60		21
	s.s.	s.	s.	128		22
	h.s.	s.	s.	108—109		23
	s.s.	s.	s.	128—129		24
0.8708/13°	i.	s.s	s.	− 93.2	110.7	25
				liq.	105—108	26
0.7624/17.5°				liq.	101	27
	i.	s.		15	193	28
1.6025/0°				liq.		29
	i.	s.		43	190.2—191.7	30
1.0621/115°	0.12 : 100/25°	v.s.		105.5—104	259	31
1.0543/112°	0.1 : 100/25°	v.s.	v.s.	111—113	263	32
	0.035 : 100/25°	v.s.	v.s.	180	274—275	33

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Toluidine, *o*	$CH_3.C_6H_4.NH_2$	107.12	C_7H_9N
2 —, *m*	,, ,,	107.12	,,
3 —, *p*	,, ,,	107.12	,,
4 Toluhydroquinone,	see Dihydroxy toluene		
5 Toluquinone, 2 : 1 : 4	$CH_3.C_6H_3:O_2$	122.08	$C_7H_6O_2$
6 Toluyl aldehyde, *o*	$CH_3.C_6H_4.CHO$	120.10	C_8H_8O
7 — —, *m*	,, ,,	120.10	,,
8 — —, *p*	,, ,,	120.10	,,
9 — —, *a*	$C_6H_5.CH_2.CHO$	120.10	,,
10 — benzoic acid, 3 : 3′	$CH_3.C_6H_4.CO.C_6H_4.COOH$	240.17	$C_{15}H_{12}O_3$
11 — — —, 4 : 2′	,, ,, $.2H_2O$	276.20	,,
12 Toluylene diamine, 1 : 2 : 3	$CH_3.C_6H_3:(NH_2)_2$	122.14	$C_7H_{10}N_2$
13 — —, 1 : 2 : 4	,, ,,	122.14	,,
14 — —, 1 : 2 : 5	,, ,,	122.14	,,
15 — —, 1 : 2 : 6	,, ,,	122.14	,,
16 — hydrate	$C_6H_5.CH_2.CHOH.C_6H_5$	198.18	$C_{14}H_{14}O$
17 Tolyl alcohol, *o*	$CH_3.C_6H_4.CH_2OH$	122.12	$C_8H_{10}O$
18 — —, *m*	,, ,,	122.12	,,
19 — —, *p*	,, ,,	122.12	,,
20 — chloride, *o*	$CH_3.C_6H_4.CH_2Cl$	140.57	C_8H_9Cl
21 — —, *m*	,, ,,	140.57	,,
22 — —, *p*	,, ,,	140.57	,,
23 — diphenyl methane, *m*	$(C_6H_5)_2:CH.C_6H_4.CH_3$	258.24	$C_{20}H_{18}$
24 — — —, *p*	,, ,,	258.24	,,
25 — hydrazine, *o*	$CH_3.C_6H_4.NH.NH_2$	122.14	$C_7H_{10}N_2$
26 — —, *m*	,, ,,	122.14	,,
27 —, *p*	,, ,,	122.14	,,
28 — phenyl ketone, *o*	$C_6H_5.CO.C_6H_4.CH_3$	196.17	$C_{14}H_{12}O$
29 — — —, *p*	,, ,,	196.17	,,
30 Tolylene alcohol, *o*	$C_6H_4:(CH_2OH)_2$	138.12	$C_8H_{10}O_2$
31 — —, *m*	,, ,,	138.12	,,
32 — —, *p*	,, ,,	138.12	,,
33 — chloride, *o*	$C_6H_4:(CH_2Cl)_2$	175.02	$C_8H_8Cl_2$
34 — —, *m*	,, ,,	175.02	,,
35 — —, *p*	,, ,,	175.02	,,
36 — cyanide, *o*	$C_6H_4:(CH_2CN)_2$	156.13	$C_{10}H_8N_2$
37 — —, *m*	,, ,,	156.13	,,

Density $H_2O=1$.	Solubility in Water.	Solubility in Alcohol.	Solubility in Ether.	M.P. °C.	B.P. °C.	
0.9986/20°				liq.	197.7	1
0.9986/20°			s.	liq.	203.3	2
0.9538/59.1°	s.s.	s.		45	200.4	3
						4
	h.s.	v.s.	v.s.	67	subl.	5
				liq.	200	6
1.024/22°				liq.	199	7
1.072/12°				liq.	204	8
1.085				liq.	205—207	9
	h.s.s.	s.	s.	228	d.	10
	h.v.s.s.	v.s.	v.s.	140	d.	11
		s.		61—62	255	12
				99	280	13
	s.	s.	s., s. C_6H_6	64	273—274	14
		s.		103.5—105		15
	i.	s.	v.s.	42		16
1.023/40°	s.s.	s.	s.	31	223/750mm.	17
0.9157/17°	s.			liq.	217	18
	h.s.s.	s.	s.	60	217—221	19
					197—199	20
1.064/20°					195—196	21
					192	22
		s.	s.	62	353—354.7 /774mm.	23
	i.	h.s.	s.	71	>360	24
	s. $CHCl_3$	s.	s.	56		25
				liq.	240—244	26
	s. C_6H_6	s.	s.	61	240—244	27
					315—316	28
	s. C_6H_6	s.s.	s.	59—60	326.5	29
	s.	s.	s.	64.2—64.8		30
1.161/18°	v.s.		s.	46—47		31
	v.s.	v.s.	v.s.	112—113		32
1.393/0°		v.s.		54.6—54.8	239—241	33
1.302/20°				34.2	250—255	34
1.417/0°				98—99	240—250	35
		v.s.	v.s.	59—60		36
		s.	s. $CHCl_3$	28—29	305—310 /300mm.	37

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Toluylene cyanide, *p*	$C_6H_4:(CH_2CN)_2$	156.13	$C_{10}H_8N_2$
2 Tri acetamide	$N(C_2H_3O)_3$	143.11	$C_6H_9O_3N$
3 — acetin	$C_3H_5(O.CO.CH_3)_3$	218.16	$C_9H_{14}O_6$
4 — acetone amine	$C_9H_{17}NO.H_2O$	173.21	$C_9H_{17}ON$
5 — amino azo benzene, 2 : 4 : 3′	$NH_2.C_6H_4.N_2.C_6H_3:(NH_2)_2$	227.21	$C_{12}H_{13}N_5$
6 — — benzene, 1 : 2 : 3	$C_6H_3(NH_2)_3$	123.13	$C_6H_9N_3$
7 — — —, 1 : 2 : 4	,,	123.13	,,
8 — — benzoic acid, 3 : 4 : 5 : 1	$(NH_2)_3C_6H_2.COOH.1\frac{1}{2}H_2O$	194.17	$C_7H_9O_2N_3$
9 — — — —, 2 : 3 : 5 : 1	,, ,,	167.14	,,
10 — — phenol	$(NH_2)_3C_6H_2OH$	139.13	$C_6H_9ON_3$
11 — amyl amine	$(C_5H_{11})N$	227.35	$C_{15}H_{33}N$
12 — azole, 1 : 2 : 4	CH : N | >NH N = CH	69.06	$C_2H_3N_3$
13 — benzoyl methane	$CH(CO.C_6H_5)_3$	328.24	$C_{22}H_{16}O_3$
14 — benzyl amine	$N(C_6H_5.CH_2)_3$	287.28	$C_{21}H_{21}N$
15 — brom acetic acid	$CBr_3.COOH$	296.78	$C_2HO_2Br_3$
16 — — benzene, 1 : 2 : 3	$C_6H_3Br_3$	314.81	$C_6H_3Br_3$
17 — — —, 1 : 3 : 4	,,	314.81	,,
18 — — —, 1 : 3 : 5	,,	314.81	,,
19 — — hydrin	$CH_2Br.CHBr.CH_2Br$	280.82	$C_3H_5Br_3$
20 — — phenol, 2 : 4 : 6	$C_6H_2OH(Br_3)$	330.81	$C_6H_3OBr_3$
21 — — resorcinol, 2 : 4 : 3	$C_6H(OH)_2(Br)_3$	346.81	$C_6H_3O_2Br_3$
22 — butyl amine	$(C_4H_9)_3N$	185.29	$C_{12}H_{27}N$
23— carballylic acid	$C_3H_5(COOH)_3$	176.09	$C_6H_8O_6$
24 — chlor acetal, 1	$CHCl_2.CCl(OC_2H_5)_2$	221.50	$C_6H_{11}O_2Cl_3$
25 — — —, 2	$CCl_3.CH(OC_2H_5)_2$	221.50	,,
26 — — acetamide	$CCl_3.CO.NH_2$	162.42	$C_2H_2ONCl_3$
27 — — acetic acid	$CCl_3.COOH$	163.40	$C_2HO_2Cl_3$
28 — — acetate, ethyl	$CCl_3.COO.C_2H_5$	191.44	$C_4H_5O_2Cl_3$
29 — — aniline, 1 : 2 : 3 : 4	$NH_2.C_6H_2Cl_3$	196.45	$C_6H_4NCl_3$
30 — — —, 1 : 2 : 4 : 5	,, ,,	196.45	,,
31 — — —, 1 : 2 : 4 : 6	,, ,,	196.45	,,
32 — — benzene, 1 : 2 : 4	$C_6H_3.Cl_3$	181.43	$C_6H_3Cl_3$
32 — — benzene, 1 : 2 : 3	,,	181.43	,,
33 — — —, 1 : 2 : 4			
34 — — —, 1 : 3 : 5	,,	181.43	,,

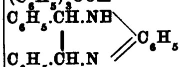
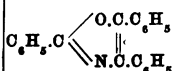
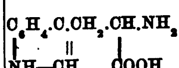
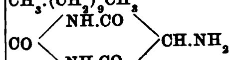
Density $H_2O=1$.	Solubility in Water.	Solubility in Alcohol.	Solubility in Ether.	M.P. °C.	B.P. °C.	
	h.s.s.	h.s.	s. $CHCl_3$	98		1
			s.	78—79		2
1.55	i.	m.	m.	liq.	258—259	3
	s.		s.	58, an. 39.6		4
	h.s.s.	v.s.	v.s., s. C_6H_6	144		5
	v.s.	v.s.	v.s.	103	330	6
	v.s.	v.s.	s.s. $CHCl_3$	<100	340	7
	h.s.	i.	i.			8
	h.s.	h.v.s.s.	i.			9
						10
				liq.	257	11
	s.	s.	s.s.	120—121	260	12
	s. CS_2	v.s.s.	v.s.s.	223—226	subl.	13
	v.s.s.	h.s.	s.	91		14
	s.	s.		135	d. 245	15
		s.		87.4		16
		s.s.		44	275—276	17
		h.s.s.		119.6	278	18
2.436/23°				16	219—221	19
	v.s.s.	v.s.		94	subl.	20
	h.s.s.	s.		112		21
0.7782/20°				171	211—215 /740mm.	22
	s.	s.	s.s.	165		23
		s.	s.	83	230	24
1.288	v.s.s.	m.	m.	liq.	199—205	25
	h.s.s.	s.	s.	141	238—239	26
1.63/61°	v.s.	s.	s.	57	196—197	27
1.369/15°	i.			liq.	164	28
				67.5	292	29
				95—96	270	30
		s.	s.	77	262	31
		s.s.		53—54	218—219	32
1.574/10° solid; 1.466/10° liq				16	213	33
				63.4	208.5	34

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Tri chlor benzoic acid, 1 : 2 : 4 : 5	$HOOC.C_6H_2Cl_3$	225.44	$C_7H_3O_2Cl_3$
2 ————, 1 : 2 : 3 : 4	,, ,,	225.44	,,
3 ————, 1 : 3 : 4 : 5	,, ,,	225.44	,,
4 —— ethane, α α β	$CH_2Cl.CHCl_2$	133.41	$C_2H_3Cl_3$
5 ———, methyl chloroform	$CH_3.CCl_3$	133.41	,,
6 —— ethylene	C_2HCl_3	131.40	C_2HCl_3
7 —— hydrin	$CH_2Cl.CHCl.CH_2Cl$	147.44	$C_3H_5Cl_3$
8 —— hydroquinone	$C_6HCl_3(OH)_2$ (2 : 3 : 5)	213.43	$C_6H_3O_2Cl_3$
9 —— lactic acid	$CCl_3.CHOH.COOH$	193.42	$C_3H_3O_3Cl_3$
10 —— phenol, 1 : 2 : 4 : 6	$OH.C_6H_2Cl_3$	197.43	$C_6H_3OCl_3$
11 ———, 1 : 2 : 3 : 5	,,	197.43	,,
12 —— quinone, 2 : 3 : 5	$C_6HO_2(Cl_3)$	211.42	$C_6HO_2Cl_3$
13 — decane	$C_{13}H_{28}$	184.29	$C_{13}H_{28}$
14 — decylene	$C_{13}H_{26}$	182.27	$C_{13}H_{26}$
15 — ethyl amine	$(C_2H_5)_3N$	101.16	$C_6H_{15}N$
16 ——— arsine	$(C_2H_5)_3As$	162.11	$C_6H_{15}As$
17 —— benzene, 1 : 3 : 5	$C_6H_3(C_2H_5)_3$	162.20	$C_{12}H_{18}$
18 —— phosphine	$(C_2H_5)_3P$	118.19	$C_6H_{15}P$
19 ——— oxide	$(C_2H_5)_3PO$	134.19	$C_6H_{15}OP$
20 ——— sulphide	$(C_2H_5)_3PS$	150.25	$C_6H_{15}SP$
21 —— silicol	$(C_2H_5)_3Si.OH$	132.46	$C_6H_{16}OSi$
22 ——— ester	$(C_2H_5)_3Si.OC_2H_5$	160.50	$C_8H_{20}OSi$
23 ——— oxide	$Si_2(C_2H_5)_6O$	246.90	$C_{12}H_{30}OSi_2$
24 — ethylene diamine	$(C_2H_4)_2N_2$	112.15	$C_6H_{12}N_2$
— hydroxy anthraquinone			
25 1. Anthragallol	$C_{14}H_5O_2(OH)_3$	256.13	$C_{14}H_8O_5$
26 2. Purpurin	,, ,, $.H_2O$	274.15	,,
27 1. Anthrapurpurin	,, ,,	256.13	,,
28 4. Flavopurpurin	,, ,,	256.13	,,
29 —— benzoic acid, 2 : 3 : 4 : 1	$C_6H_2(OH)_3COOH$ ($\frac{1}{2}H_2O$)	170.06	$C_7H_6O_5$
30 —— benzo phenone	$C_{13}H_{10}O_4$	230.15	$C_{13}H_{10}O_4$
31 —— methylene, α	$C_3H_6O_3$	90.06	$C_3H_6O_3$
32 —— pyridine, 2 : 4 : 6	$C_5H_2N(OH_3)$	127.08	$C_5H_5O_3N$
33 — iodo benzene, 1 : 2 : 3	$C_6H_3I_3$	455.81	$C_6H_3I_3$
34 ———, 1 : 2 : 4	,,	455.81	,,

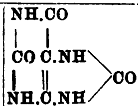
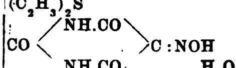
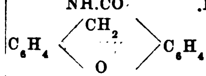
Density $H_2O=1$.	Solubility in Water.	Solubility in Alcohol.	Solubility in Ether.	M.P. °C.	B.P. °C.	
	h.s.	s.		163	subl.	1
	v.s.			129		2
	v.s.s.	s.	s., s. C_6H_6	203	subl.	3
1.4406/25.5°					114	4
1.3349/26°					74	5
					88	6
1.417/15°				liq.	154—156	7
	h.s.	s.	s.	134		8
	s.	s.	s.	115—118		9
	v.s.s.	v.s.	v.s.	68	243.5—244.5	10
	h.s.	s.	s.	53—54	252—253	11
	v.s.s.	h.s.	s.	165—166		12
0.7608/15°				− 6.2	234	13
0.8445/0°					232.7	14
0.7331/15°	s.s.	s.		liq.	89	15
1.151/17°	i.			liq.	140/736mm.	16
					217—220	17
0.812/15°	i.	s.	s.	liq.	127.5/744	18
		m.	m.	52.9	242.9	19
				95	subl. 120—145	20
0.8709/0°	i.			liq.	154	21
0.8403/0°				liq.	153	22
0.859/0°				liq.	231	23
				liq.	210	24
	v.s.s.	s.	s.	310	subl. 290	25
	s.s.	s.	s., s. C_6H_6	256	subl. 150	26
	h.s.s.	h.s.	s.s.	369	462	27
	h.s.s.	s.	s.s.	> 330	459	28
1.094/4°	h.s.	s.	v.s.	an. 110		29
		h.s.	s. C_6H_6	133—134		30
	s.	s.	i.	152	subl.	31
	s.s.	i.	i.	220—230 d.		32
		s.		116	subl.	33
				91.4		34

	Name.	Formula.	Formula Weight.	Empirical Formula.
1	Tri iodo benzene, 1:3:5	$C_6H_3I_3$	455.81	$C_6H_3I_3$
2	— mellitic acid, 1:2:4	$C_6H_3(COOH)_3$	210.09	$C_9H_6O_6$
3	— mesic acid, 1:4:5	,,	210.09	,,
4	— methyl acetic acid	$(CH_3)_3C.COOH$	102.10	$C_5H_{10}O_2$
5	— — amine	$(CH_3)_3N$	59.10	C_3H_9N
6	— — arsine	$(CH_3)_3As$	120.05	C_3H_9As
7	— — benzene, 1 : 2 : 3	$C_6H_3(CH_3)_3$	120.14	C_9H_{12}
8	— — benzoic acid, 1 : 3 : 5 : 2	$(CH_3)_3C_6H_2.COOH$	165.15	$C_{10}H_{12}O_2$
9	— — ethylene	$(CH_3)_2:C:CH.CH_3$	70.10	C_5H_{10}
10	— — phosphine	$(CH_3)_3P$	76.13	C_3H_9P
11	— — quinoline, 2 : 3 : 4	$C_{12}H_{13}N$	171.17	$C_{12}H_{13}N$
12	— — —, 2 : 5 : 7	,,	171.17	,,
13	— — —, 2 : 3 : 6	,,	171.17	,,
14	— — —, 2 : 6 : 8	,,	171.17	,,
15	— — —, 2 : 4 : 6	,,	171.17	,,
16	— methylene bromide	$CH_2Br.CH_2.CH_2Br$	201.90	$C_3H_6Br_2$
17	— — diamine	$NH_2.(CH_2)_3.NH_2$	74.12	$C_3H_{10}N_2$
18	— — dicarboxylic acid	$\begin{array}{l}CH_2\\ \vert \\ CH_2\end{array}\!\!>C:(COOH)_2$	130.07	$C_5H_6O_4$
19	— — glycol	$CH_2OH.CH_2.CH_2OH$	76.08	$C_3H_8O_2$
20	— nitro acetonitrile	$C(NO_2)_3.CN$	86.10	$C_2O_6N_4$
21	— — aniline, see	Picramide		
22	— — benzene, 1 : 3 : 5	$C_6H_3(NO_2)_3$	213.08	$C_6H_3O_6N_3$
23	— — naphthalene, 1 : 3 : 5	$C_{10}H_5(NO_2)_3$	263.12	$C_{10}H_5O_6N_3$
24	— — —, 1 : 3 : 8	,,	263.12	,,
25	— — —, 1 : 4 : 5	,,	263.12	,,
26	— — orcinol	$C_6(NO_2)_3(CH_3)(OH)_2$	259.10	$C_7H_5O_8N_3$
27	— — phenol, 1 : 2 : 4 : 6, picric acid	$OH.C_6H_2(NO_2)_3$	229.08	$C_6H_3O_7N_3$
28	— — —, 1 : 3 : 4 : 6	,,	229.08	,,
29	— — —, 1 : 2 : 3 : 6	,,	229.08	,,
30	— — resorcinol	$C_6H(NO_2)_3(OH)_2$	245.08	$C_6H_3O_8N_3$
31	— — toluene, 1 : 2 : 4 : 6	$CH_3.C_6H_2(NO_2)_3$	227.10	$C_7H_5O_6N_3$
32	— — —, 1 : 3 : 4 : 6	,,	227.10	,,
33	— — —, β	,,	227.10	,,

Density $H_2O=1$.	Solubility in Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
				182—184		1
	v.s.		v.s.	215—217		2
	h.s.	v.s.	s.	345—350	subl.	3
0.905/50°	1 : 45/20°			38	162—164	4
0.673/0°	v.s.	v.s.			3.2—3.8	5
	s.s.				70	6
0.8694/10°					175—175.5	7
	h.s.s.	v.s.	v.s.	152		8
0.6783/0°					36.4—37.2	9
$>H_2O$	i.			liq.	40—42	10
				65	285	11
	s.	v.s.	s.s.	43	285—287	12
		s.	s.	86—87	285	13
	i.	v.s.	s.	45—46	266—267 /780mm.	14
	s.			63—64	277—278	15
1.973/17°				liq.	160—163 /719mm.	16
		m.	m.		135—136 /738mm.	17
	v.s		s.	139		18
1.0526/18°	m.			liq.	216	19
	d.	d.	s.	41.5		20
						21
	h.s.	h.s.	s., s. C_6H_6	122	d.	22
	s. acetic.	s.	s. $CHCl_3$	122		24
	v.s.s. $CHCl_3$	v.s.s.	v.s.s.	218		23
	s.s. C_6H_6	s.s.	s.s.	154		25
	h.s.	s. C_6H_6	s.s.	163.5		26
1.767/19°	1.525 : 100/30°	s.	s.	122.5	subl. expl.	27
	h.s.	v.s.	v.s.	96		28
	h.s.	v.s.	v.s.	117—118		29
	s.s.	s.	s.	175.5	subl.	30
		h.s.		80.8—80.85		31
	s. acetone.	v.s.s.	s., s. C_6H_6	104		32
	s. acetone.	hs., s. C_6H_6	s., s. CS_2	112		33

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Tri nitro xylene, 2 : 4 : 6 : 1 : 3	$C_6H(NO_2)_3(CH_3)_2$	241.13	$C_8H_7O_6N_3$
2 — — —, 2 : 3 : 5 : 1 : 4	,, ,,	241.13	,,
3 — phenyl amine	$(C_6H_5)_3N$	245.22	$C_8H_{15}N$
4 — — benzene, 1 : 3 : 5	$C_6H_3(C_6H_5)_3$	306.26	$C_{24}H_{18}$
5 — — carbinol	$(C_6H_5)_3COH$	260.22	$C_{19}H_{16}O$
6 — — dihydro glyoxaline		298.27	$C_{21}H_{18}N_2$
7 — — guanidine, *a*	$C_6H_5.N:C:(NH.C_6H_5)_2$	287.17	$C_{19}H_{17}N_3$
8 — — —, *β*	,, ,,	287.17	,,
9 — — methane	$(C_6H_5)_3CH$	244.22	$C_{19}H_{16}$
10 — — — carboxylic acid	$(C_6H_5)_2:CH.C_6H_4.COOH$	288.22	$C_{20}H_{16}O_2$
11 — — oxazole		297.24	$C_{21}H_{15}ON$
12 — quinonyl	$C_6H_{16}O_{14}$	312.16	$C_6H_{16}O_{14}$
13 — thiocarbonic acid	$CS(SH)_2$	110.20	CH_2S_3
14 Tropic acid, *i*	$C_6H_5.CH(COOH).CH_2OH$	166.13	$C_9H_{10}O_3$
15 — —, *d*	,, ,,	166.13	,,
16 — —, *l*	,, ,,	166.13	,,
17 Tropidine	$C_8H_{13}N$	123.15	$C_8H_{13}N$
18 Tryptophane		204.17	$C_{11}H_{12}O_2N_2$
19 Tyrosine, *o*	$OH.C_6H_4.C_2H_3(NH_2)COOH$	181.14	$C_9H_{11}O_3N$
20 —, *m*	,, ,,	181.14	,,
21 —, *d*	,, ,,	181.14	,,
22 —, *l*	,, ,,	181.14	,,
23 Umbellic acid	$C_9H_8O_4$	180.00	$C_9H_8O_4$
24 Umbelliferone	$C_9H_6O_3$	162.09	$C_9H_6O_3$
25 Undecane	$CH_3.(CH_2)_9CH_3$	156.25	$C_{11}H_{24}$
26 Uramil		143.09	$C_4H_5O_3N_3$
27 Urea	$CO:(NH_2)_2$	60.06	CH_4ON_2
28 Urethane	$CO(NH_2)OC_2H_5$	89.08	$C_3H_7O_2N$

Density $H_2O=1$.	Solubility in Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
		h.s.s.		182		1
		h.v.s.		139—140		2
		s.s.	s. C_6H_6	127	347—348	3
1.206	s. C_6H_6	s.s. (50%)	s.s.	170	>300	4
		s.	s.	162.5	>360	5
	i.	s.	s.	113, iso. 198		6
	h.v.s.s.	s.		143	d.	7
	v.s.s.	s.	s.	311		8
1.0166/95°	h.s. C_6H_6	h.s.	s.	94—95	358—359 /754mm.	9
	i.	s.	s.	162		10
		s.	s.	115		11
	h.s.	i.	i.	95 d.		12
	i.			liq.		13
	s.	s.	s.	117—118	d.	14
				127—128		15
				123		16
0.9467/19°, 0.9665/0°	c.s., h.s.s.	v.s.	v.s.	liq.	162—163	17
	s.	i.	i.	289		18
1.456	h.s.	v.s.s.	i.	249—250		19
				280—281		20
				310—314		21
				295 d.		22
	h.s.	s.	i.	d. 125		23
	h.s.	s.	s.s.	223—224	subl.	24
0.756/0°, 0.7448/15°				26.5	194	25
	h.s.s.		s. NH_4OH			26
1.323	1 : 1	1 : 20	s.s.	132—133	d.	27
0.9862/21°	s.	s.	s.	49—50	184	28

	Name.	Formula.	Formula Weight.	Empirical Formula.
1	Uric acid		168.10	$C_5H_4O_3N_4$
2	Urotropine, see	Hexamethylene tetramine		
3	Usnic acid, *d*	$C_{18}H_{16}O_7$	344.22	$C_{18}H_{16}O_7$
4	— —, *l*	„	344.22	„
5	Uvitic acid, 1 : 3 : 5	$CH_3.C_6H_3:(COOH)_2$	180.11	$C_9H_8O_4$
6	— —, *iso.*	„ „	180.11	„
7	Uvitonic acid	$CH_3.C_5H_2N:(COOH)_2$	181.11	$C_8H_7O_4N$
8	Valeraldehyde, norm.	$CH_3.(CH_2)_3.CHO$	86.11	$C_5H_{10}O$
9	—, *iso.*	$(CH_3)_2:CH.CH_2CHO$	86.11	„
10	Valeramide	$C_4H_9.CO.NH_2$	101.12	$C_5H_{11}ON$
11	Valeric acid, 1, norm.	$CH_3.(CH_2)_3.COOH$	102.10	$C_5H_{10}O_2$
12	— —, 2, Iso propyl acetic acid	$(CH_3)_2:CH.CH_2.COOH$	102.10	„
13	— —, 3, Pivalic acid, see	Trimethyl acetic acid		
14	Valerate, iso, iso amyl	$C_4H_9.COO.C_5H_{11}$	172.21	$C_{10}H_{20}O_2$
15	—, —, ethyl	$C_4H_9.COO.C_2H_5$	130.15	$C_7H_{14}O_2$
16	—, methyl	$C_4H_9.COO.CH_3$	116.13	$C_6H_{12}O_2$
17	Valeric anhydride	$(C_4H_9.CO)_2:O$	186.19	$C_{10}H_{18}O_3$
18	Valerylene	$(CH_3)_2:C:C.CH_2$	68.09	C_5H_8
19	Vanillic acid	$C_6H_3(OCH_3)(OH)COOH$	168.10	$C_8H_8O_4$
20	— alcohol	$C_6H_3(OCH_3)(OH)CH_2OH$	154.12	$C_8H_{10}O_3$
21	Vanillin, 3 : 1 : 4	$C_6H_3(OCH_3)(OH)CHO$	152.10	$C_8H_8O_3$
22	Veratrol	$C_6H_4:(OCH_3)_2$	138.12	$C_8H_{10}O_2$
23	Vinyl amine	$C_2H_3.NH_2$	43.06	C_2H_5N
24	— bromide	$CH_2:CHBr$	106.95	C_2H_3Br
25	— chloride	$CH_2:CHCl$	62.49	C_2H_3Cl
26	— sulphide	$(C_2H_3)_2S$	86.13	C_4H_6S
27	Violuric acid		175.09	$C_4H_3O_4N_3$
28	Xanthene		182.15	$C_{13}H_{10}O$
29	Xanthogen amide	$CS(OC_2H_5)NH_2$	105.14	C_3H_7ONS
30	Xanthogenic acid	$CS(OC_2H_5)SH$	122.18	$C_3H_6OS_2$

Density $H_2O=1$.	Solubility in Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
1.855—1.893	v.s.s.	i.	i.	d.	d.	1
						2
	i.	s.s.	s.	195—196	d.	3
				197—198		4
	h.v.s.s.	s.	s.	274	subl.	5
	h.s.	s.	s.	175		6
	v.s.s.	s. ac.	s. aniline	274 d.		7
0.8185/11.2°	s.s.	s.		liq.	103.4	8
0.8041/15°	s.s.	s.	s.	liq.	92—93	9
	s.	s.	s.	126—128	230—232	10
0.9415/20°	1 : 27/16°			− 18 to −20	185	11
0.9298/20°	1 : 24/20°			− 51	173.7	12
						13
0.8765/20°	s.s.	m.	m.	liq.	189—190 /757.4mm.	14
0.9007/0°	i.	s.		liq.	144.6	15
0.9097/0°					127.3	16
0.9290/27°				liq.	205	17
0.7000/0°				liq.	55.5—56	18
	h.s.	s.		211	subl.	19
	h.s.	s.	s.	115		20
	h.s.	s.	s.	81	subl.	21
1.086/15°				22.7	205—207	22
					56	23
1.5167/14°				liq.	16/750mm.	24
				− 15		25
0.9125	s.s.	m.	m.		101	26
	h.s.	s.				27
	v.s.s.	s.	s.	105	300—301	28
	s.s.	s.	s.s.	98		29
>H_2O	i.			liq.	d. 24	30

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Xanthogenate, ethyl	$CS(OC_2H_5)S.C_2H_5$	150.23	$C_5H_{10}OS_2$
2 Xanthone	$C_6H_4\left<\begin{matrix}CO\\O\end{matrix}\right>C_6H_4$	196.13	$C_{13}H_8O_2$
3 Xanthopurpurin	$C_6H_4:(CO)_2:C_6H_2:(OH)_2$	240.13	$C_{14}H_8O_4$
4 Xylene, *o*	$(CH_3)_2:C_6H_4$	106.12	C_8H_{10}
5 —, *m*	" "	106.12	"
6 —, *p*	" "	106.12	"
7 — dihydro, 1 : 3 : 1 : 2	$(CH_3)_2:C_6H_4(H_2)$	108.14	C_8H_{12}
8 — —, 1 : 4 : 1 : 2	" "	108.14	"
9 — —, 1 : 5 : 1 : 2	" "	108.14	"
10 — —, 3 : 5 : 1 : 2	" "	108.14	"
11 — —, 3 : 6 : 1 : 2	" "	108.14	"
12 — —, 4 : 5 : 1 : 2	" "	108.14	"
13 — —, 2 : 5 : 1 : 4	" "	108.14	"
14 —, hexahydro, *p*	C_8H_{16}	112.17	C_8H_{16}
15 —, tetrahydro, *m*, 1 : 2 : 3 : 4	C_8H_{14}	110.15	C_8H_{14}
16 — sulphonic acid, 1 : 2 : 4	$C_6H_3(CH_3)_2SO_3H$	186.18	$C_8H_{10}O_3S$
17 Xylenol, 1 : 2 : 3	$C_6H_3(CH_3)_2OH$	122.12	$C_8H_{10}O$
18 —, 1 : 2 : 4	" "	122.12	"
19 —, 1 : 3 : 2	" "	122.12	"
20 —, 1 : 3 : 4	" "	122.12	"
21 —, 1 : 3 : 5	" "	122.12	"
22 —, 1 : 4 : 2	" "	122.12	"
23 Xylic acid, 1 : 3 : 4	$C_6H_3(CH_3)_2COOH$	150.13	$C_9H_{10}O_2$
24 — —, 1 : 2 : 4	" "	150.13	"
25 — —, 1 : 3 : 2	" "	150.13	"
26 Xylidic acid, 1 : 2 : 5	$C_6H_3(CH_3)(COOH)_2$	180.11	$C_9H_8O_4$
27 — —, 1 : 2 : 4	" "	180.11	"
28 — —, 1 : 2 : 3	" "	180.11	"
29 Xylidine, 1 : 2 : 3	$C_6H_3(CH_3)_2NH_2$	121.14	$C_8H_{11}N$
30 —, 1 : 2 : 4	" "	121.14	"
31 —, 1 : 3 : 4	" "	121.14	"
32 —, 1 : 3 : 5	" "	121.14	"

Density $H_2O=1$.	Solubility in Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
1.065/19°		s.		liq.	200	1
	h.s.s.	h.s.	s.s.	173—174	349—350 /730mm.	2
	s. C_6H_6	s.	s. acetic	262—263	subl.	3
0.8633/20°	i.	v.s.	v.s.	− 27.1	144.6	4
0.8642/20°	i.	v.s.	v.s.	− 54.8	138.8—139.2	5
0.8612/20°	i.	v.s.	v.s.	13.2	137.8—138.1	6
			s.	liq.	131.5—133 /740mm.	7
					132.5—133.5	8
					129—130 /745mm.	9
					132—134	10
					135—138	11
					135.5—136.5	12
					133—134 /720mm.	13
0.795/4°				liq.	120—120.2 /768mm.	14
0.814/0°					124—125	15
	s.			d.	19	16
	s.	s.		75	218	17
	s.	s.		65	225	18
	h.v.s.	s.		49	211—212	19
1.0362/0°	v.s.s.	m.	m.	26	211.5	20
0.9709/81°	s.	s.		64	219.5	21
0.98/8°	s.	s.		74.5	211.5	22
	h.s.s.	s.	s.	126—127	267/727mm.	23
	h.v.s.s.	v.s.		165—166		24
	s.			97—99	274.5	25
	h.s.s.	s.		280—283		26
	s.s.	h.v.s.		320—330	subl.	27
				144 d.		28
0.991/15°				liq.	223/739mm.	29
1.0755/17.5°	s.s.		s. ligroin.	49	226	30
0.9184/15°				liq.	212	31
0.9935/0°				liq.	220—221	32

Name.	Formula.	Formula Weight.	Empirical Formula.
1 Xylidine, 1 : 4 : 2	$C_6H_3(CH_3)_2NH_2$	121.14	$C_8H_{11}N$
2 Xyloquinone, 2 : 3	$(CH_3)_2C_6H_2O_2$	136.10	$C_8H_8O_2$
3 —, 2 : 6	" "	136.10	"
4 —, 2 : 5	" "	136.10	"
5 Xylorcin, 1 : 3 : 4 : 6	$(CH_3)_2 : C_6H_2 : (OH)_2$	138.12	$C_8H_{10}O_2$
6 Xylose, *d*	$C_4H_5(OH)_4CHO$	150.11	$C_5H_{10}O_5$
7 Zinc diethyl	$Zn(C_2H_5)_2$	123.47	$C_4H_{10}Zn$
8 — dimethyl	$Zn(CH_3)_2$	95.43	C_2H_6Zn

Density $H_2O=1$.	Solubility in— Water.	Alcohol.	Ether.	M.P. °C.	B.P. °C.	
0.98/15°				15.5	215/739mm.	1
	s.s.	s.	s.	55	subl	2
				72—73		3
	h.s.s.	s.s.	s.	61	subl.	4
	s.	s.	s.	124—125	276—279	5
	v.s.			141.5—143		6
1.182/18°	d.	d.	s.	- 28	118	7
1.386/10.5°	d.			- 40	46	8

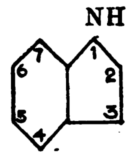
Notation of Organic Compounds (Richter).

In numbering positions in the case of substitution derivatives of phenol, aniline, toluene, etc., the characteristic radical of each of these substances is regarded as in position 1.

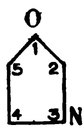
Furan.

Thiophen.

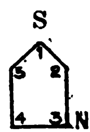
Pyrrole.



Indole.

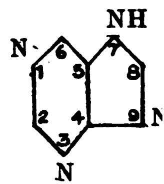


Oxazole.



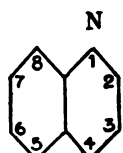
Thiazole

Pyrazole.

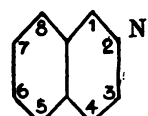


Purine.

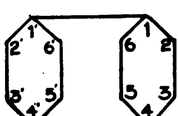
Pyridine



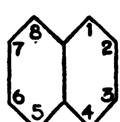
Quinoline.



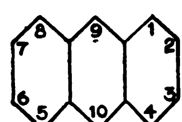
*iso*Quinoline.



Diphenyl



Naphthalene



Anthracene.

USEFUL MEMORANDA.

Weight of 1 cc. of dry air at N.T.P.	=	0·001293 grm.
„ „ hydrogen „	=	0·0000899 grm.
„ „ nitrogen „	=	0·001257 grm.
„ „ mercury at 0°C.	=	13·596 grm.

1 grm. of hydrogen at N.T.P. occupies 11·12 litres.
16 grm. of oxygen at N.T.P. occupy 11·20 litres.
Molecular wt. in grm. of any gas occupies 22·40 litres (O = 16)
or 22·24 litres (H = 1)

Density of hydrogen (air = 1)	=	0·0695
„ air (hydrogen = 1)	=	14·38
Average % oxygen in air by volume	=	20·96

1 gallon of water weighs 10 lbs. and occupies 0·1604 c. ft.
1 c. ft. of water weighs 62·3 lbs.
Weight in lbs. per c. in.: Cast iron, 0·26; wrought iron, 0·28; steel, 0·29; brass, 0·298; copper, 0·319; lead, 0·412.

CONVERSION TABLES FOR WEIGHTS AND MEASURES.

The Regulations of the Board of Trade (March, 1907) state:

"The Yard is the length at 62°F. marked on a bronze bar deposited with the Board of Trade.

"The Pound is the weight of a piece of platinum weighed *in vacuo* at 0°C. which is deposited with the Board of Trade.

"The Gallon contains 10 lbs. weight of distilled water weighed in air against brass weights, with the water and the air at the temperature of 62°F., the barometer being at 30 inches.

"The Metre is the length, at the temperature of 0°C., of the iridio-platinum bar, numbered 16, deposited with the Board of Trade.

"The Kilogramme is represented by the iridio-platinum weight, numbered 18, deposited with the Board of Trade.

"The Litre is represented by the capacity at 0°C. of the cylindrical brass measure, marked 'Litre, 1897' (which is deposited with the Board of Trade)."

The legalised fundamental equivalents, from which the conversion tables have been calculated, are as follows:

1 Kilogramme	=	15432·3564 grains
1 Metre	=	39·370113 inches
1 Gallon	=	4·5459631 litres

Linear Measures.

Imperial units.	Metric units.	Log. of factor.
1 inch	2.5400 cm.	0.40483
1 link (=7.92 inches)	20.117 cm.	1.30356
1 foot (=12 inches)	30.480 cm.	1.48401
1 yard (=3 feet)	91.440 cm.	1.96114
1 pole (=5½ yards)	5.0292 metres	0.70150
1 chain (=100 links)	20.117 metres	1.30356
1 furlong (=40 poles)	201.17 metres	2.30356
1 mile (=8 furlongs)	1609.34 metres	3.20665

Metric units.	Imperial units.	Log of factor.
1 centimetre	0.39370 inches	$\bar{1}$.59517
1 metre	3.2808 feet	0.51598
	or 1.0936 yards	0.03886
1 kilometre	0.62137 mile	$\bar{1}$.79335

Superficial Measures.

Imperial units.	Metric units.	Log. of factor.
1 sq. in.	6.4516 sq. cm.	0.80967
1 sq. ft. (=144 sq. ins.)	929.03 sq. cm.	2.96803
1 sq. yd. (=9 sq. ft.)	8361.26 sq. cm.	3.92228
1 acre (=4840 sq. yds.)	4046.85 sq. metres	3.60712
	or 40.4685 ares	1.60712
1 sq. mile (=640 acres)	25899.8 ares	4.41330
	or 2.58998 sq. kilometres	0.41330

Metric units.	Imperial units.	Log. of factor.
1 sq. cm.	0.15500 sq. in	$\bar{1}$.19033
1 sq. m.	1550.0 sq. in	3.19033
	or 10.764 sq. ft.	1.03197
	or 1.1960 sq. yds.	0.07773
1 are	119.60 sq. yds.	2.07773
1 hectare	2.4711 acres	0.39289
1 sq. km.	0.38610 sq. m.	$\bar{1}$.58670

Cubical Measures.

Imperial units.	Metric units.	Log. of factor.
1 c. in.	16.387 cc.	1.21450
1 c. ft. (=1728 c. in.)	28316 cc.	4.45205
1 c. yd. (=27 c. ft.)	0.76455 c. m. (or stere)	$\bar{1}$.88341

Metric units.	Imperial units.	Log. of factor.
1 cc	0.061024 c. in.	$\bar{2}$.78550
1 litre	0.035315 c. ft.	$\bar{2}$.54796
1 stere or c. m.	35.315 c. ft.	1.54796
	or 1.30795 c. yds	0.11659

Measures of Capacity.

Imperial units.	Metric units.	Log. of factor.
1 minim (♏)	0.059192 cc.	$\bar{2}$.77226
1 fluid scruple	1.1838 cc.	0.07327
1 fluid drachm (=60 minims)	3.5515 cc	0.55041
1 fluid ounce (fl. ℥)	28.412 cc.	1.45350
1 gill (=5 fl. ozs.)	0.14206 litres	$\bar{1}$.15247
1 pint (=4 gills)	0.56825 litres	$\bar{1}$.75454
1 gallon (=8 pints)	4.5460 litres	0.65763
1 peck (=2 gallons)	9.0919 litres	0.95865
1 bushel (=4 pecks)	36.368 litres	1.56072
1 quarter (=8 bushels)	290.94 litres	2.46380

Metric units.	Imperial units.	Log. of factor.
1 cc.	0.0070392 gills	$\bar{3}$.84752
1 litre	1.7598 pints	0.24547
	or 0.21998 gallons	$\bar{1}$.34239
1 decalitre	1.0999 pecks	0.04136
1 hectolitre	2.7497 bushels	0.43928

Measures of Capacity

used in the British Pharmacopœia, 1914.

1 centimil (Cl)	= 0.01 cc.	=	0.169 minims.
1 decimil (Dl)	= 0.1 cc.	=	1.69 minims.
1 millilitre or mil (Ml)	= 1 cc.	=	16.9 minims.
1 litre (Lit)	= 1000 cc.	=	35.196 fluid ozs.

Measures of Weight.

Imperial units.	Metric units.	Log. of factor.
1 grain	0.064799 grm.	$\bar{2}$.81157
1 dram (avoir.)	1.7718 grm.	0.24842
1 ounce ,,	28.3495 grm.	1.45255
1 pound ,,	453.5924 grm.	2.65666
1 stone ,,	6.3503 kgm.	0.80279
1 quarter ,,	12.7006 kgm.	1.10382
1 cwt. ,,	50.8024 kgm.	1.70588
1 ton ,,	1016.05 kgm.	3.00691
	or 1.01605 tonnes	0.00691
1 scruple (apoth.)	1.2960 grm.	0.11260
1 pennyweight (troy)	1.5552 grm.	0.19179
1 drachm (ʒ) (apoth.)	3.8879 grm.	0.58971
1 ounce (℥) (troy and apoth.)	31.103 grm.	1.49280
1 pound (troy and apoth.)	373.24 grm.	2.57199

Metric units.	Imperial units.	Log. of factor.
1 gramme	15.432 grains	1.18843
	or 0.56438 drams (avoir.)	$\bar{1}$.75157
	or 0.035274 oz. (avoir.)	$\bar{2}$.54746
1 kilogramme	2.2046 lbs.	0.34333
1 quintal	1.9684 cwt.	0.29412
1 tonne	0.98420 ton	$\bar{1}$.99308

Signs used for Medical Prescriptions.

½ grain	... gr. ss.	1 drachm	... ʒ i, or ʒ j.
1 ,,	... gr. j, or gr. i.	1½ ,,	... ʒ iss.
1½ ,,	... gr. iss.	2 ,,	... ʒ ii. or ʒ ij.
2 ,,	... gr. ii, or gr. ij.	3 ,,	... ʒ iii, or ʒ iij
2½ ,,	... gr. iiss.	3½ ,,	... ʒ iiiss.
4 ,,	... gr. iv.	½ ounce	... ℥ ss.
8 ,,	... gr. viii. or gr. viij.	1 ,,	... ℥ i, or ℥ j.
½ scruple	... ℈ ss.	1½ ,,	... ℥ iss.
1 ,,	... ℈ i. or ℈ j.	½ pint	... Oss.
1½ ,,	... ℈ iss.	1 ,,	... Oi or Oj
2 ,,	... ℈ ii, or ℈ ij.	1 gallon	... Ci or Cj

FIVE-FIGURE LOGARITHMS

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
100	00000	043	087	130	173	217	260	303	346	389	4	8	13	17	21	26	30	35	39
101	432	475	518	561	604	647	689	732	775	817	4	8	13	17	21	26	30	34	39
102	860	903	945	988	*030*	*072*	*115*	*157*	*199*	*242*	4	8	13	17	21	25	30	34	38
103	01284	326	368	410	452	494	536	578	620	662	4	8	13	17	21	25	30	34	38
104	703	745	787	828	870	912	953	995	*036*	*078*	4	8	12	17	21	25	29	34	38
105	02119	160	202	243	284	325	366	407	449	490	4	8	12	17	21	25	29	33	37
106	531	572	612	653	694	735	776	816	857	898	4	8	12	16	20	24	29	33	37
107	938	979	*019*	*060*	*100*	*141*	*181*	*222*	*262*	*302*	4	8	12	16	20	24	28	32	36
108	03342	383	423	463	503	543	583	623	663	703	4	8	12	16	20	24	28	32	36
109	743	782	822	862	902	941	981	*021*	*060*	*100*	4	8	12	16	20	24	28	32	36
110	04139	179	218	258	297	336	376	415	454	493	4	8	12	16	20	24	27	31	35
111	532	571	610	650	689	727	766	805	844	883	4	8	12	16	20	23	27	31	35
112	922	961	999	*038*	*077*	*115*	*154*	*192*	*231*	*269*	4	8	12	16	20	23	27	31	35
113	05308	346	385	423	461	500	538	576	614	652	4	8	11	15	19	23	27	30	34
114	690	729	767	805	843	881	918	956	994	*032*	4	8	11	15	19	23	26	30	34
115	06070	108	145	183	221	258	296	333	371	408	4	8	11	15	19	23	26	30	34
116	446	483	521	558	595	633	670	707	744	781	4	7	11	15	19	22	26	30	33
117	819	856	893	930	967	*004*	*041*	*078*	*115*	*151*	4	7	11	15	19	22	25	29	33
118	07188	225	262	298	335	372	408	445	482	518	4	7	11	15	18	22	25	29	33
119	555	591	628	664	700	737	773	809	846	882	4	7	11	15	18	22	25	29	32
120	918	954	990	*027*	*063*	*099*	*135*	*171*	*207*	*243*	4	7	11	14	18	22	25	29	32
121	08279	314	350	386	422	458	493	529	565	600	4	7	11	14	18	21	25	29	32
122	636	672	707	743	778	814	849	884	920	955	4	7	11	14	18	21	25	28	32
123	991	*025*	*061*	*096*	*132*	*167*	*202*	*237*	*272*	*307*	4	7	11	14	18	21	25	28	32
124	09342	377	412	447	482	517	552	587	621	656	3	7	10	14	18	21	24	28	31
125	691	726	760	795	830	864	899	934	968	*003*	3	7	10	14	17	21	24	28	31
126	10037	072	106	140	175	209	243	278	312	346	3	7	10	14	17	21	24	27	31
127	380	415	449	483	517	551	585	619	653	687	3	7	10	14	17	20	24	27	31
128	721	755	789	823	856	890	924	958	992	*025*	3	7	10	14	17	20	24	27	30
129	11059	093	126	160	193	227	260	294	327	361	3	7	10	13	17	20	24	27	30
130	394	428	461	494	528	561	594	628	661	694	3	7	10	13	17	20	23	27	30
131	727	760	793	826	860	893	926	959	992	*024*	3	7	10	13	17	20	23	26	30
132	12057	090	123	156	189	222	254	287	320	352	3	7	10	13	16	20	23	26	29
133	385	418	450	483	516	548	581	613	646	678	3	6	10	13	16	20	23	26	29
134	710	743	775	808	840	872	905	937	969	*001*	3	6	10	13	16	19	23	26	29
135	13033	066	098	130	162	194	226	258	290	322	3	6	10	13	16	19	22	26	29
136	354	386	418	450	481	513	545	577	609	640	3	6	10	13	16	19	22	25	29
137	672	704	735	767	799	830	862	893	925	956	3	6	10	13	16	19	22	25	28
138	988	*019*	*051*	*082*	*114*	*145*	*176*	*208*	*239*	*270*	3	6	9	13	16	19	22	25	28
139	14301	333	364	395	426	457	489	520	551	582	3	6	9	12	16	19	22	25	28

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
140	14613	644	675	706	737	768	799	829	860	891	3	6	9	12	15	19	22	25	28
141	922	953	983	*014*	*045*	*076*	*106*	*137*	*168*	*198*	3	6	9	12	15	18	21	25	28
142	15229	259	290	320	351	381	412	442	473	503	3	6	9	12	15	18	21	24	27
143	534	564	594	625	655	685	715	746	776	806	3	6	9	12	15	18	21	24	27
144	836	866	897	927	957	987	*017*	*047*	*077*	*107*	3	6	9	12	15	18	21	24	27
145	16137	167	197	227	256	286	316	346	376	406	3	6	9	12	15	18	21	24	27
146	435	465	495	524	554	584	613	643	673	702	3	6	9	12	15	18	21	24	27
147	732	761	791	820	850	879	909	938	967	997	3	6	9	12	15	18	21	24	26
148	17026	056	085	114	143	173	202	231	260	289	3	6	9	12	15	18	20	23	26
149	319	348	377	406	435	464	493	522	551	580	3	6	9	12	15	17	20	23	26
150	609	638	667	696	725	754	782	811	840	869	3	6	9	12	14	17	20	23	26
151	898	926	955	984	*013*	*041*	*070*	*099*	*127*	*156*	3	6	9	11	14	17	20	23	26
152	18184	213	241	270	298	327	355	384	412	441	3	6	9	11	14	17	20	23	25
153	469	498	526	554	583	611	639	667	696	724	3	6	9	11	14	17	20	23	25
154	752	780	808	837	865	893	921	949	977	*005*	3	6	8	11	14	17	20	23	25
155	19033	061	089	117	145	173	201	229	257	285	3	6	8	11	14	17	20	22	25
156	312	340	368	396	424	451	479	507	535	562	3	6	8	11	14	17	20	22	25
157	590	618	645	673	700	728	756	783	811	838	3	5	8	11	14	17	19	22	25
158	866	893	921	948	976	*003*	*030*	*058*	*085*	*112*	3	5	8	11	14	16	19	22	25
159	20140	167	194	222	249	276	303	330	358	385	3	5	8	11	14	16	19	22	25
160	412	439	466	493	520	547	575	602	629	656	3	5	8	11	14	16	19	22	24
161	683	710	736	763	790	817	844	871	898	925	3	5	8	11	13	16	19	22	24
162	951	978	*005*	*032*	*059*	*085*	*112*	*139*	*165*	*192*	3	5	8	11	13	16	19	21	24
163	21219	245	272	299	325	352	378	405	431	458	3	5	8	11	13	16	19	21	24
164	484	511	537	564	590	617	643	669	696	722	3	5	8	11	13	16	18	21	24
165	748	775	801	827	854	880	906	932	958	985	3	5	8	10	13	16	18	21	24
166	22011	037	063	089	115	141	167	194	220	246	3	5	8	10	13	16	18	21	23
167	272	298	324	350	376	401	427	453	479	505	3	5	8	10	13	16	18	21	23
168	531	557	583	608	634	660	686	712	737	763	3	5	8	10	13	15	18	21	23
169	789	814	840	866	891	917	943	968	994	*019*	3	5	8	10	13	15	18	21	23
170	23045	070	096	121	147	172	198	223	249	274	3	5	8	10	13	15	18	20	23
171	300	325	350	376	401	426	452	477	502	528	3	5	8	10	13	15	18	20	23
172	553	578	603	629	654	679	704	729	754	779	3	5	8	10	13	15	18	20	23
173	805	830	855	880	905	930	955	980	*005*	*030*	2	5	7	10	13	15	18	20	23
174	24055	080	105	130	155	180	204	229	254	279	2	5	7	10	12	15	17	20	22
175	304	329	353	378	403	428	452	477	502	527	2	5	7	10	12	15	17	20	22
176	551	576	601	625	650	674	699	724	748	773	2	5	7	10	12	15	17	20	22
177	797	822	846	871	895	920	944	969	993	*018*	2	5	7	10	12	15	17	20	22
178	25042	066	091	115	139	164	188	212	237	261	2	5	7	10	12	15	17	19	22
179	285	310	334	358	382	406	431	455	479	503	2	5	7	10	12	15	17	19	22

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
180	25527	551	575	600	624	648	672	696	720	744	2	5	7	10	12	14	17	19	22
181	768	792	816	840	864	888	912	935	959	983	2	5	7	10	12	14	17	19	22
182	26007	031	055	079	102	126	150	174	198	221	2	5	7	10	12	14	17	19	21
183	245	269	293	316	340	364	387	411	435	458	2	5	7	10	12	14	17	19	21
184	482	505	529	553	576	600	623	647	670	694	2	5	7	9	12	14	17	19	21
185	717	741	764	788	811	834	858	881	905	928	2	5	7	9	12	14	16	19	21
186	951	975	998	*021*	*045*	*068*	*091*	*114*	*138*	*161*	2	5	7	9	12	14	16	19	21
187	27184	207	231	254	277	300	323	346	370	393	2	5	7	9	12	14	16	19	21
188	416	439	462	485	508	531	554	577	600	623	2	5	7	9	12	14	16	18	21
189	646	669	692	715	738	761	784	807	829	852	2	5	7	9	11	14	16	18	21
190	875	898	921	944	967	989	*012*	*035*	*058*	*081*	2	5	7	9	11	14	16	18	21
191	28103	126	149	171	194	217	240	262	285	307	2	5	7	9	11	14	16	18	20
192	330	353	375	398	420	443	466	488	510	533	2	5	7	9	11	14	16	18	20
193	556	578	601	623	646	668	691	713	735	758	2	4	7	9	11	13	16	18	20
194	780	803	825	847	870	892	914	937	959	981	2	4	7	9	11	13	16	18	20
195	29003	026	048	070	092	115	137	159	181	203	2	4	7	9	11	13	16	18	20
196	226	248	270	292	314	336	358	380	403	425	2	4	7	9	11	13	15	18	20
197	447	469	491	513	535	557	579	601	623	646	2	4	7	9	11	13	15	18	20
198	667	688	710	732	754	776	798	820	842	863	2	4	7	9	11	13	15	18	20
199	885	907	929	951	973	994	*016*	*038*	*060*	*081*	2	4	7	9	11	13	15	17	20
200	30103	125	146	168	190	211	233	255	276	298	2	4	7	9	11	13	15	17	20
201	320	341	363	384	406	428	449	471	492	514	2	4	6	9	11	13	15	17	19
202	535	557	578	600	621	642	664	685	707	728	2	4	6	9	11	13	15	17	19
203	750	771	792	814	835	856	877	899	920	942	2	4	6	9	11	13	15	17	19
204	963	984	*006*	*027*	*048*	*069*	*091*	*112*	*133*	*154*	2	4	6	8	11	13	15	17	19
205	31175	197	218	239	260	281	302	323	345	366	2	4	6	8	11	13	15	17	19
206	387	408	429	450	471	492	513	534	555	576	2	4	6	8	11	13	15	17	19
207	597	618	639	660	681	702	723	744	765	785	2	4	6	8	10	13	15	17	19
208	806	827	848	869	890	911	931	952	973	994	2	4	6	8	10	13	15	17	19
209	32015	035	056	077	098	118	139	160	181	201	2	4	6	8	10	12	15	17	19
210	222	243	263	284	305	325	346	366	387	408	2	4	6	8	10	12	14	16	18
211	428	449	469	490	510	531	552	572	593	613	2	4	6	8	10	12	14	16	18
212	634	654	675	695	715	736	756	777	797	818	2	4	6	8	10	12	14	16	18
213	838	858	879	899	919	940	960	980	*001*	*021*	2	4	6	8	10	12	14	16	18
214	33041	062	082	102	122	143	163	183	203	224	2	4	6	8	10	12	14	16	18
215	244	264	284	304	325	345	365	385	405	425	2	4	6	8	10	12	14	16	18
216	445	465	486	506	526	546	566	586	606	626	2	4	6	8	10	12	14	16	18
217	646	666	686	706	726	746	766	786	806	826	2	4	6	8	10	12	14	16	18
218	846	866	885	905	925	945	965	985	*005*	*025*	2	4	6	8	10	12	14	16	18
219	34044	064	084	104	124	143	163	183	203	223	2	4	6	8	10	12	14	16	18

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
220	34242	262	282	301	321	341	361	381	400	420	2	4	6	8	10	12	14	16	18
221	439	459	479	498	518	537	557	577	596	616	2	4	6	8	10	12	14	16	18
222	636	655	674	694	713	733	753	772	792	811	2	4	6	8	10	12	14	16	18
223	830	850	869	889	908	928	947	966	986	*005*	2	4	6	8	10	12	14	16	18
224	35025	044	064	083	102	122	141	160	180	199	2	4	[illegible]	8	10	12	14	15	17
225	218	238	257	276	295	315	334	353	372	392	2	4	6	8	10	12	14	15	17
226	411	430	449	468	488	507	526	545	564	583	2	4	6	8	10	12	13	15	17
227	603	622	641	660	679	698	717	736	755	774	2	4	6	8	10	11	13	15	17
228	793	813	832	851	870	889	908	927	946	965	2	4	6	8	10	11	13	15	17
229	984	*003*	*021*	*040*	*059*	*078*	*097*	*116*	*135*	*154*	2	4	6	8	9	11	13	15	17
230	36173	192	211	229	248	267	286	305	324	342	2	4	6	8	9	11	13	15	17
231	361	380	399	418	437	455	474	493	511	530	2	4	6	8	9	11	13	15	17
232	549	568	586	605	624	642	661	680	698	717	2	4	6	7	9	11	13	15	17
233	736	754	773	791	810	829	847	866	884	903	2	4	6	7	9	11	13	15	17
234	922	940	959	977	996	*014*	*033*	*051*	*070*	*088*	2	4	6	7	9	11	13	15	17
235	37107	125	144	162	181	200	218	236	254	273	2	4	6	7	9	11	13	15	17
236	291	310	328	346	365	383	401	420	438	457	2	4	6	7	9	11	13	15	17
237	475	493	511	530	548	566	585	603	621	639	2	4	5	7	9	11	13	15	16
238	658	676	694	712	731	749	767	785	803	822	2	4	5	7	9	11	13	15	16
239	840	858	876	894	912	931	949	967	985	*003*	2	4	5	7	9	11	13	14	16
240	38021	039	057	075	093	112	130	148	166	184	2	4	5	7	9	11	13	14	16
241	202	220	238	256	274	292	310	328	346	364	2	4	5	7	9	11	13	14	16
242	382	399	417	435	453	471	489	507	525	543	2	4	5	7	9	11	13	14	16
243	561	578	596	614	632	650	668	686	703	721	2	4	5	7	9	11	12	14	16
244	739	757	775	792	810	828	846	863	881	899	2	4	5	7	9	11	12	14	16
245	917	934	952	970	987	*005*	*023*	*041*	*058*	*076*	2	4	5	7	9	11	12	14	16
246	39094	111	129	146	164	182	199	217	235	252	2	4	5	7	9	11	12	14	16
247	270	287	305	322	340	358	375	393	410	428	2	4	5	7	9	11	12	14	16
248	445	463	480	498	515	533	550	568	585	602	2	3	5	7	9	10	12	14	16
249	620	637	655	672	690	707	724	742	759	777	2	3	5	7	9	10	12	14	16
250	794	811	829	846	863	881	898	915	933	950	2	3	5	7	9	10	12	14	16
251	967	985	*002*	*019*	*037*	*054*	*071*	*088*	*106*	*123*	2	3	5	7	9	10	12	14	16
252	40140	157	174	192	209	226	243	261	278	295	2	3	5	7	9	10	12	14	15
253	312	329	346	364	381	398	415	432	449	466	2	3	5	7	9	10	12	14	15
254	483	500	518	535	552	569	586	603	620	637	2	3	5	7	9	10	12	14	15
255	654	671	688	705	722	739	756	773	790	807	2	3	5	7	8	10	12	14	15
256	824	841	858	875	892	909	926	943	959	976	2	3	5	7	8	10	12	14	15
257	993	*010*	*027*	*044*	*061*	*078*	*095*	*111*	*128*	*145*	2	3	5	7	8	10	12	13	15
258	41162	179	196	212	229	246	263	280	296	313	2	3	5	7	8	10	12	13	15
259	330	347	363	380	397	414	430	447	464	481	2	3	5	7	8	10	12	13	15

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260	41497	514	531	547	564	581	597	614	631	647	2	3	5	7	8	10	12	13	15
261	664	680	697	714	731	747	764	781	797	814	2	3	5	7	8	10	12	13	15
262	830	847	863	880	896	913	929	946	963	979	2	3	5	7	8	10	12	13	15
263	996	*012*	*029*	*045*	*062*	*078*	*095*	*111*	*127*	*143*	2	3	5	7	8	10	12	13	15
264	42160	177	193	209	226	243	259	275	292	308	2	3	5	7	8	10	11	13	15
265	325	341	357	374	390	406	423	439	465	472	2	3	5	7	8	10	11	13	15
266	488	504	521	537	553	570	586	602	619	635	2	3	5	7	8	10	11	13	15
267	651	667	684	700	716	732	749	765	781	797	2	3	5	6	8	10	11	13	15
268	813	830	846	862	878	894	910	927	943	959	2	3	5	6	8	10	11	13	15
269	975	991	*008*	*024*	*040*	*056*	*072*	*088*	*104*	*120*	2	3	5	6	8	10	11	13	14
270	43136	152	169	185	201	217	233	249	265	281	2	3	5	6	8	10	11	13	14
271	297	313	329	345	361	377	393	409	425	441	2	3	5	6	8	10	11	13	14
272	457	473	489	505	521	537	553	569	585	600	2	3	5	6	8	10	11	13	14
273	616	632	648	664	680	696	712	727	743	759	2	3	5	6	8	10	11	13	14
274	775	791	807	823	838	854	870	886	902	917	2	3	5	6	8	10	11	13	14
275	933	949	965	981	996	*012*	*028*	*044*	*059*	*075*	2	3	5	6	8	9	11	13	14
276	44091	107	122	138	154	170	185	201	217	232	2	3	5	6	8	9	11	13	14
277	248	264	279	295	311	326	342	358	373	389	2	3	5	6	8	9	11	13	14
278	404	420	436	451	467	483	498	514	529	545	2	3	5	6	8	9	11	12	14
279	560	576	592	607	623	638	654	669	685	700	2	3	5	6	8	9	11	12	14
280	716	731	747	762	778	793	809	824	840	855	2	3	5	6	8	9	11	12	14
281	871	886	902	917	932	948	963	979	994	*010*	2	3	5	6	8	9	11	12	14
282	45025	040	056	071	086	102	117	133	148	163	2	3	5	6	8	9	11	12	14
283	179	194	209	225	240	255	271	286	301	317	2	3	5	6	8	9	11	12	14
284	332	347	362	378	393	408	423	439	454	469	2	3	5	6	8	9	11	12	14
285	484	500	515	530	545	560	576	591	606	621	2	3	5	6	8	9	11	12	14
286	637	652	667	682	697	712	728	743	758	773	2	3	5	6	8	9	11	12	14
287	788	803	818	834	849	864	879	894	909	924	2	3	5	6	8	9	11	12	14
288	939	954	969	984	*000*	*015*	*030*	*045*	*060*	*075*	2	3	5	6	8	9	11	12	14
289	46090	105	120	135	150	165	180	195	210	225	1	3	4	6	8	9	10	12	13
290	240	255	270	285	300	315	330	344	359	374	1	3	4	6	7	9	10	12	13
291	389	404	419	434	449	464	479	494	509	523	1	3	4	6	7	9	10	12	13
292	538	553	568	583	598	613	627	642	657	672	1	3	4	6	7	9	10	12	13
293	687	702	716	731	746	761	776	790	805	820	1	3	4	6	7	9	10	12	13
294	835	849	864	879	894	909	923	938	953	967	1	3	4	6	7	9	10	12	13
295	982	997	*012*	*026*	*041*	*056*	*070*	*085*	*100*	*114*	1	3	4	6	7	9	10	12	13
296	47129	144	159	173	188	202	217	232	246	261	1	3	4	6	7	9	10	12	13
297	276	290	305	319	334	349	363	378	392	407	1	3	4	6	7	9	10	12	13
298	422	436	451	466	480	494	509	524	538	553	1	3	4	6	7	9	10	12	13
299	567	582	596	611	625	640	654	669	683	698	1	3	4	6	7	9	10	12	13

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300	47712	727	741	756	770	784	799	813	828	842	1	3	4	6	7	9	10	12	13
301	857	871	885	900	914	929	943	958	972	986	1	3	4	6	7	9	10	12	13
302	48001	015	029	044	058	073	087	101	116	130	1	3	4	6	7	9	10	11	13
303	144	159	173	187	202	216	230	244	258	273	1	3	4	6	7	9	10	11	13
304	287	302	316	330	344	359	373	387	401	416	1	3	4	6	7	9	10	11	13
305	430	444	458	473	487	501	515	530	544	558	1	3	4	6	7	9	10	11	13
306	572	586	601	615	629	643	657	671	686	700	1	3	4	6	7	9	10	11	13
307	714	728	742	756	770	785	799	813	827	841	1	3	4	6	7	8	10	11	13
308	855	869	883	887	911	926	940	954	968	982	1	3	4	6	7	8	10	11	13
309	996	*010*	*024*	*038*	*052*	*066*	*080*	*094*	*108*	*122*	1	3	4	6	7	8	10	11	13
310	49136	150	164	178	192	206	220	234	248	262	1	3	4	6	7	8	10	11	13
311	276	290	304	318	332	346	360	374	388	402	1	3	4	6	7	8	10	11	13
312	415	429	443	457	471	485	499	513	527	541	1	3	4	6	7	8	10	11	13
313	554	568	582	596	610	624	638	651	665	679	1	3	4	6	7	8	10	11	12
314	693	707	721	734	748	762	776	790	803	817	1	3	4	6	7	8	10	11	12
315	831	845	859	872	886	900	914	927	941	955	1	3	4	5	7	8	10	11	12
316	969	983	996	*010*	*024*	*037*	*051*	*065*	*079*	*092*	1	3	4	5	7	8	10	11	12
317	50106	119	133	147	161	174	188	202	215	229	1	3	4	5	7	8	10	11	12
318	243	256	270	284	297	311	325	338	352	365	1	3	4	5	7	8	10	11	12
319	379	393	407	420	433	447	461	474	488	501	1	3	4	5	7	8	10	11	12
320	515	529	542	556	569	583	596	610	624	637	1	3	4	5	7	8	9	11	12
321	650	664	678	691	705	718	732	745	759	772	1	3	4	5	7	8	9	11	12
322	786	799	813	826	839	853	866	880	893	907	1	3	4	5	7	8	9	11	12
323	920	934	947	961	974	987	*001*	*014*	*028*	*041*	1	3	4	5	7	8	9	11	12
324	51054	068	081	095	108	121	135	148	161	175	1	3	4	5	7	8	9	11	12
325	188	202	215	228	242	255	268	282	295	308	1	3	4	5	7	8	9	11	12
326	322	335	348	362	375	388	402	415	428	442	1	3	4	5	7	8	9	11	12
327	455	468	481	495	508	521	534	548	561	574	1	3	4	5	7	8	9	11	12
328	587	501	614	627	640	654	667	680	693	706	1	3	4	5	7	8	9	11	12
329	720	733	746	759	772	786	799	812	825	838	1	3	4	5	7	8	9	11	12
330	851	865	878	891	904	917	930	943	957	970	1	3	4	5	7	8	9	11	12
331	983	996	*009*	*022*	*035*	*048*	*061*	*075*	*088*	*101*	1	3	4	5	7	8	9	10	12
332	52114	127	140	153	166	179	192	205	218	231	1	3	4	5	7	8	9	10	12
333	244	257	270	284	297	310	323	336	349	362	1	3	4	5	7	8	9	10	12
334	375	388	401	414	427	440	453	466	479	492	1	3	4	5	6	8	9	10	12
335	504	517	530	543	556	569	582	595	608	621	1	3	4	5	6	8	9	10	12
336	634	647	660	673	686	699	711	724	737	750	1	3	4	5	6	8	9	10	12
337	763	776	789	802	815	827	840	853	866	879	1	3	4	5	6	8	9	10	12
338	892	905	917	930	943	956	969	982	994	*007*	1	3	4	5	6	8	9	10	12
339	53020	033	046	058	071	084	097	110	122	135	1	3	4	5	6	8	9	10	12

340] Five-figure Logarithms—*continued.* [·53

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340	53148	161	173	186	199	212	224	237	250	263	1	3	4	5	6	8	9	10	11
341	275	288	301	314	326	339	352	364	377	390	1	3	4	5	6	8	9	10	11
342	403	415	428	441	453	466	479	491	504	517	1	3	4	5	6	8	9	10	11
343	529	542	555	567	580	593	605	618	631	643	1	3	4	5	6	8	9	10	11
344	656	668	681	694	706	719	732	744	757	769	1	3	4	5	6	8	9	10	11
345	782	794	807	820	832	845	857	870	882	895	1	3	4	5	6	8	9	10	11
346	908	920	933	945	958	970	983	995	*008*	*020*	1	3	4	5	6	8	9	10	11
347	54033	045	058	070	083	095	108	120	133	145	1	2	4	5	6	8	9	10	11
348	158	170	183	195	208	220	233	245	258	270	1	2	4	5	6	7	9	10	11
349	283	295	308	320	332	345	357	369	382	394	1	2	4	5	6	7	9	10	11
350	407	419	432	444	456	469	481	494	506	518	1	2	4	5	6	7	9	10	11
351	531	543	555	568	580	593	605	617	630	642	1	2	4	5	6	7	9	10	11
352	654	667	679	691	704	716	728	741	753	765	1	2	4	5	6	7	9	10	11
353	777	790	802	814	827	839	851	864	876	888	1	2	4	5	6	7	9	10	11
354	900	913	925	937	949	962	974	986	998	*011*	1	2	4	5	6	7	9	10	11
355	55023	035	047	060	072	084	096	108	121	133	1	2	4	5	6	7	9	10	11
356	145	157	169	182	194	206	218	230	242	255	1	2	4	5	6	7	9	10	11
357	267	279	291	303	315	328	340	352	364	376	1	2	4	5	6	7	9	10	11
358	388	400	413	425	437	449	461	473	485	497	1	2	4	5	6	7	8	10	11
359	509	522	534	546	558	570	582	594	606	618	1	2	4	5	6	7	8	10	11
360	630	642	654	666	678	691	703	715	727	739	1	2	4	5	6	7	8	10	11
361	751	763	775	787	799	811	823	835	847	859	1	2	4	5	6	7	8	10	11
362	871	883	895	907	919	931	943	955	967	979	1	2	4	5	6	7	8	10	11
363	991	*003*	*015*	*027*	*038*	*050*	*062*	*074*	*086*	*098*	1	2	4	5	6	7	8	10	11
364	56110	122	134	146	158	170	182	194	205	217	1	2	4	5	6	7	8	10	11
365	229	241	253	265	277	289	301	312	324	336	1	2	4	5	6	7	8	10	11
366	348	360	372	384	396	407	419	431	443	455	1	2	4	5	6	7	8	9	10
367	467	478	490	502	514	526	538	549	561	573	1	2	4	5	6	7	8	9	10
368	585	597	608	620	632	644	656	667	679	691	1	2	4	5	6	7	8	9	10
369	703	714	726	738	750	761	773	785	797	808	1	2	4	5	6	7	8	9	10
370	820	832	844	855	867	879	891	902	914	926	1	2	4	5	6	7	8	9	10
371	937	949	961	972	984	996	*008*	*019*	*031*	*043*	1	2	4	5	6	7	8	9	10
372	57054	066	078	089	101	113	124	136	148	159	1	2	3	5	6	7	8	9	10
373	171	183	194	206	217	229	241	252	264	276	1	2	3	5	6	7	8	9	10
374	287	299	310	322	334	345	357	368	380	392	1	2	3	5	6	7	8	9	10
375	403	415	426	438	449	461	473	484	496	507	1	2	3	5	6	7	8	9	10
376	519	530	542	553	565	576	588	600	611	623	1	2	3	5	6	7	8	9	10
377	634	646	657	669	680	692	703	715	726	738	1	2	3	5	6	7	8	9	10
378	749	761	772	784	795	807	818	830	841	852	1	2	3	5	6	7	8	9	10
379	864	875	887	898	910	921	933	944	955	967	1	2	3	5	6	7	8	9	10

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380	57978	990	*001*	*013*	*024*	*035*	*047*	*058*	*070*	*081*	1	2	3	5	6	7	8	9	10
381	58092	104	115	127	138	149	161	172	184	195	1	2	3	5	6	7	8	9	10
382	206	218	229	240	252	263	274	286	297	309	1	2	3	5	6	7	8	9	10
383	320	331	343	354	365	377	388	399	410	422	1	2	3	5	6	7	8	9	10
384	433	444	456	467	478	490	501	512	524	535	1	2	3	5	6	7	8	9	10
385	546	557	569	580	591	602	614	625	636	647	1	2	3	4	6	7	8	9	10
386	659	670	681	692	704	715	726	737	749	760	1	2	3	4	6	7	8	9	10
387	771	782	794	805	816	827	838	850	861	872	1	2	3	4	6	7	8	9	10
388	883	894	906	917	928	939	950	961	973	984	1	2	3	4	6	7	8	9	10
389	995	*006*	*017*	*028*	*040*	*051*	*062*	*073*	*084*	*095*	1	2	3	4	6	7	8	9	10
390	59106	118	129	140	151	162	173	184	195	207	1	2	3	4	6	7	8	9	10
391	218	229	240	251	262	273	284	295	306	318	1	2	3	4	6	7	8	9	10
392	329	340	351	362	373	384	395	406	417	428	1	2	3	4	6	7	8	9	10
393	439	450	461	472	483	494	506	517	528	539	1	2	3	4	6	7	8	9	10
394	550	561	572	583	594	605	616	627	638	649	1	2	3	4	5	7	8	9	10
395	660	671	682	693	704	715	726	737	748	759	1	2	3	4	5	7	8	9	10
396	770	780	791	802	813	824	835	846	857	868	1	2	3	4	5	7	8	9	10
397	879	890	901	912	923	934	945	956	966	977	1	2	3	4	5	7	8	9	10
398	988	999	*010*	*021*	*032*	*043*	*054*	*065*	*076*	*086*	1	2	3	4	5	7	8	9	10
399	60097	108	119	130	141	152	163	173	184	195	1	2	3	4	5	7	8	9	10
400	206	217	228	239	249	260	271	282	293	304	1	2	3	4	5	7	8	9	10
401	314	325	336	347	358	369	379	390	401	412	1	2	3	4	5	6	8	9	10
402	423	433	444	455	466	477	487	498	509	520	1	2	3	4	5	6	8	9	10
403	530	541	552	563	574	584	595	606	617	627	1	2	3	4	5	6	8	9	10
404	638	649	660	670	681	692	703	713	724	735	1	2	3	4	5	6	8	9	10
405	745	756	767	778	788	799	810	820	831	842	1	2	3	4	5	6	7	9	10
406	853	863	874	885	895	906	917	927	938	949	1	2	3	4	5	6	7	9	10
407	959	970	981	991	*002*	*013*	*023*	*034*	*045*	*055*	1	2	3	4	5	6	7	9	10
408	61066	077	087	098	109	119	130	140	151	162	1	2	3	4	5	6	7	9	10
409	172	183	194	204	215	225	236	247	257	268	1	2	3	4	5	6	7	8	10
410	278	289	299	310	321	331	342	352	363	374	1	2	3	4	5	6	7	8	10
411	384	395	405	416	426	437	448	458	469	479	1	2	3	4	5	6	7	8	10
412	490	500	511	521	532	542	553	563	574	584	1	2	3	4	5	6	7	8	9
413	595	606	616	627	637	648	658	669	679	690	1	2	3	4	5	6	7	8	9
414	700	711	721	732	742	752	763	773	784	794	1	2	3	4	5	6	7	8	9
415	805	815	826	836	847	857	868	878	888	899	1	2	3	4	5	6	7	8	9
416	909	920	930	941	951	961	972	982	993	*003*	1	2	3	4	5	6	7	8	9
417	62014	024	034	045	055	065	076	086	097	107	1	2	3	4	5	6	7	8	9
418	118	128	138	149	159	170	180	190	201	211	1	2	3	4	5	6	7	8	9
419	221	232	242	252	263	273	284	294	304	315	1	2	3	4	5	6	7	8	9

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420	62325	335	346	356	366	377	387	397	408	418	1	2	3	4	5	6	7	8	9
421	428	439	449	459	469	480	490	500	511	521	1	2	3	4	5	6	7	8	9
422	531	542	552	562	572	583	593	603	613	624	1	2	3	4	5	6	7	8	9
423	634	644	655	665	675	685	696	706	716	726	1	2	3	4	5	6	7	8	9
424	737	747	757	767	778	788	798	808	818	829	1	2	3	4	5	6	7	8	9
425	839	849	859	870	880	890	900	910	921	931	1	2	3	4	5	6	7	8	9
426	941	951	961	972	982	992	*002*	*012*	*022*	*033*	1	2	3	4	5	6	7	8	9
427	63043	053	063	073	083	094	104	114	124	134	1	2	3	4	5	6	7	8	9
428	144	155	165	175	185	195	205	215	225	236	1	2	3	4	5	6	7	8	9
429	246	256	266	276	286	296	306	317	327	337	1	2	3	4	5	6	7	8	9
430	347	357	367	377	387	397	407	417	428	438	1	2	3	4	5	6	7	8	9
431	448	458	468	478	488	498	508	518	528	538	1	2	3	4	5	6	7	8	9
432	548	558	568	579	589	599	609	619	629	639	1	2	3	4	5	6	7	8	9
433	649	659	669	679	689	699	709	719	729	739	1	2	3	4	5	6	7	8	9
434	749	759	769	779	789	799	809	819	829	839	1	2	3	4	5	6	7	8	9
435	849	859	869	879	889	899	909	919	929	939	1	2	3	4	5	6	7	8	9
436	949	959	969	979	988	998	*008*	*018*	*028*	*038*	1	2	3	4	5	6	7	8	9
437	64048	058	068	078	088	098	108	118	128	137	1	2	3	4	5	6	7	8	9
438	147	157	167	177	187	197	207	217	227	237	1	2	3	4	5	6	7	8	9
439	246	256	266	276	286	296	306	316	326	335	1	2	3	4	5	6	7	8	9
440	345	355	365	375	385	395	404	414	424	434	1	2	3	4	5	6	7	8	9
441	444	454	464	473	483	493	503	513	523	532	1	2	3	4	5	6	7	8	9
442	542	552	562	572	582	591	601	611	621	631	1	2	3	4	5	6	7	8	9
443	640	650	660	670	680	689	699	709	719	729	1	2	3	4	5	6	7	8	9
444	738	748	758	768	777	787	797	807	816	826	1	2	3	4	5	6	7	8	9
445	836	846	856	865	875	885	895	904	914	924	1	2	3	4	5	6	7	8	9
446	933	943	953	963	972	982	992	*002*	*011*	*021*	1	2	3	4	5	6	7	8	9
447	65031	040	050	060	070	079	089	099	108	118	1	2	3	4	5	6	7	8	9
448	128	137	147	157	167	176	186	196	205	215	1	2	3	4	5	6	7	8	9
449	225	234	244	254	263	273	283	292	302	312	1	2	3	4	5	6	7	8	9
450	321	331	341	350	360	369	379	388	398	408	1	2	3	4	5	6	7	8	9
451	418	428	437	447	456	466	475	485	495	504	1	2	3	4	5	6	7	8	9
452	514	523	533	543	552	562	571	581	591	600	1	2	3	4	5	6	7	8	9
453	610	619	629	639	648	657	667	676	686	696	1	2	3	4	5	6	7	8	9
454	706	715	725	734	744	753	763	772	782	792	1	2	3	4	5	6	7	8	9
455	801	811	820	830	839	849	858	868	877	887	1	2	3	4	5	6	7	8	9
456	896	906	916	925	935	944	954	963	973	982	1	2	3	4	5	6	7	8	9
457	992	*001*	*011*	*020*	*030*	*039*	*049*	*058*	*068*	*077*	1	2	3	4	5	6	7	8	9
458	66087	096	106	115	124	134	144	153	162	172	1	2	3	4	5	6	7	8	9
459	181	191	200	210	219	229	238	247	257	266	1	2	3	4	5	6	7	8	9

460] Five-figure Logarithms—*continued.* [·66

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
460	66276	285	295	305	314	323	332	342	351	361	1	2	3	4	5	6	7	8	8
461	370	380	389	398	408	417	427	436	445	455	1	2	3	4	5	6	7	8	8
462	464	474	483	492	502	511	521	530	539	549	1	2	3	4	5	6	7	8	8
463	558	567	577	586	596	605	614	624	633	642	1	2	3	4	5	6	7	8	8
464	652	661	671	680	689	699	708	717	727	736	1	2	3	4	5	6	7	7	8
465	745	755	764	773	783	792	801	811	820	829	1	2	3	4	5	6	7	7	8
466	839	848	857	867	876	885	894	904	913	922	1	2	3	4	5	6	7	7	8
467	932	941	950	960	969	978	987	996	*006*	*015*	1	2	3	4	5	6	6	7	8
468	67025	034	043	052	062	071	080	089	099	108	1	2	3	4	5	6	6	7	8
469	117	127	136	145	154	164	173	182	191	200	1	2	3	4	5	6	6	7	8
470	210	219	228	237	247	256	265	274	284	293	1	2	3	4	5	6	6	7	8
471	302	311	321	330	339	348	357	367	376	385	1	2	3	4	5	6	6	7	8
472	394	403	413	422	431	440	449	459	468	477	1	2	3	4	5	6	6	7	8
473	486	495	504	514	523	532	541	550	560	569	1	2	3	4	5	5	6	7	8
474	578	587	596	605	614	624	633	642	651	660	1	2	3	4	5	5	6	7	8
475	669	678	688	697	706	715	724	733	742	752	1	2	3	4	5	5	6	7	8
476	761	770	779	788	797	806	815	825	834	843	1	2	3	4	5	5	6	7	8
477	852	861	870	879	888	897	906	915	925	934	1	2	3	4	5	5	6	7	8
478	943	952	961	970	979	988	997	*006*	*015*	*024*	1	2	3	4	5	5	6	7	8
479	68034	043	052	061	070	079	088	097	106	115	1	2	3	4	5	5	6	7	8
480	124	133	142	151	160	169	178	187	196	205	1	2	3	4	5	5	6	7	8
481	215	224	233	242	251	260	269	278	287	296	1	2	3	4	5	5	6	7	8
482	305	314	323	332	341	350	359	368	377	386	1	2	3	4	4	5	6	7	8
483	395	404	413	422	431	440	449	458	467	476	1	2	3	4	4	5	6	7	8
484	485	494	502	511	520	529	538	547	556	565	1	2	3	4	4	5	6	7	8
485	574	583	592	601	610	619	628	637	646	655	1	2	3	4	4	5	6	7	8
486	664	673	681	690	699	708	717	726	735	744	1	2	3	4	4	5	6	7	8
487	753	762	771	780	789	797	806	815	824	833	1	2	3	4	4	5	6	7	8
488	842	851	860	869	878	886	895	904	913	922	1	2	3	4	4	5	6	7	8
489	931	940	949	958	966	975	984	993	*002*	*011*	1	2	3	4	4	5	6	7	8
490	69020	028	037	046	055	064	073	082	090	099	1	2	3	4	4	5	6	7	8
491	108	117	126	135	144	152	161	170	179	188	1	2	3	4	4	5	6	7	8
492	197	205	214	223	232	241	249	258	267	276	1	2	3	4	4	5	6	7	8
493	285	293	302	311	320	329	338	346	355	364	1	2	3	4	4	5	6	7	8
494	373	381	390	399	408	417	425	434	443	452	1	2	3	4	4	5	6	7	8
495	461	469	478	487	496	504	513	522	531	539	1	2	3	3	4	5	6	7	8
496	548	557	566	574	583	592	601	609	618	627	1	2	3	3	4	5	6	7	8
497	636	644	653	662	671	679	688	697	705	714	1	2	3	3	4	5	6	7	8
498	723	732	740	749	758	767	775	784	793	801	1	2	3	3	4	5	6	7	8
499	810	819	827	836	845	854	862	871	880	888	1	2	3	3	4	5	6	7	8

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500	69897	906	914	923	932	940	949	958	966	975	1	2	3	3	4	5	6	7	8
501	984	992	*001*	*010*	*018*	*027*	*036*	*044*	*053*	*062*	1	2	3	3	4	5	6	7	8
502	70070	079	088	096	105	114	122	131	140	148	1	2	3	3	4	5	6	7	8
503	157	166	174	183	191	200	209	217	226	234	1	2	3	3	4	5	6	7	8
504	243	252	260	269	278	286	295	303	312	321	1	2	3	3	4	5	6	7	8
505	329	338	346	355	364	372	381	389	398	406	1	2	3	3	4	5	6	7	8
506	415	424	432	441	449	458	467	475	484	492	1	2	3	3	4	5	6	7	8
507	501	509	518	526	535	544	552	561	569	578	1	2	3	3	4	5	6	7	8
508	586	595	603	612	621	629	638	646	655	663	1	2	3	3	4	5	6	7	8
509	672	680	689	697	706	714	723	731	740	748	1	2	3	3	4	5	6	7	8
510	757	766	774	783	791	800	808	817	825	834	1	2	3	3	4	5	6	7	8
511	842	851	859	868	876	885	893	902	910	919	1	2	3	3	4	5	6	7	8
512	927	936	944	952	961	969	978	986	995	*003*	1	2	3	3	4	5	6	7	8
513	71012	020	029	037	046	054	062	071	079	088	1	2	3	3	4	5	6	7	8
514	096	105	113	122	130	139	147	155	164	172	1	2	3	3	4	5	6	7	8
515	181	189	198	206	214	223	231	240	248	257	1	2	3	3	4	5	6	7	8
516	265	273	282	290	299	307	315	324	332	341	1	2	3	3	4	5	6	7	8
517	349	357	366	374	383	391	399	408	416	425	1	2	3	3	4	5	6	7	8
518	433	441	450	458	466	475	483	492	500	508	1	2	3	3	4	5	6	7	8
519	517	525	533	542	550	559	567	575	584	592	1	2	2	3	4	5	6	7	8
520	600	609	617	625	634	642	650	659	667	675	1	2	2	3	4	5	6	7	8
521	684	692	700	709	717	725	734	742	750	759	1	2	2	3	4	5	6	7	8
522	767	775	784	792	800	809	817	825	834	842	1	2	2	3	4	5	6	7	7
523	850	858	867	875	883	892	900	908	917	925	1	2	2	3	4	5	6	7	7
524	933	941	950	958	966	975	983	991	999	*008*	1	2	2	3	4	5	6	7	7
525	72016	024	032	041	049	057	066	074	082	090	1	2	2	3	4	5	6	7	7
526	099	107	115	123	132	140	148	156	165	173	1	2	2	3	4	5	6	7	7
527	181	189	198	206	214	222	230	239	247	255	1	2	2	3	4	5	6	7	7
528	263	272	280	288	296	304	313	321	329	337	1	2	2	3	4	5	6	7	7
529	346	354	362	370	378	387	395	403	411	419	1	2	2	3	4	5	6	7	7
530	428	436	444	452	460	469	477	485	493	501	1	2	2	3	4	5	6	7	7
531	509	518	526	534	542	550	558	567	575	583	1	2	2	3	4	5	6	7	7
532	591	599	607	616	624	632	640	648	656	665	1	2	2	3	4	5	6	7	7
533	673	681	689	697	705	713	722	730	738	746	1	2	2	3	4	5	6	7	7
534	754	762	770	779	787	795	803	811	819	837	1	2	2	3	4	5	6	6	7
535	835	843	852	860	868	876	884	892	900	908	1	2	2	3	4	5	6	6	7
536	916	925	933	941	949	957	965	973	981	989	1	2	2	3	4	5	6	6	7
537	997	*006*	*014*	*022*	*030*	*038*	*046*	*054*	*062*	*070*	1	2	2	3	4	5	6	6	7
538	73078	086	094	102	111	119	127	135	143	151	1	2	2	3	4	5	6	6	7
539	159	167	175	183	191	199	207	215	223	231	1	2	2	3	4	5	6	6	7

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540	73239	247	255	264	272	280	288	296	304	312	1	2	2	3	4	5	6	6	7
541	320	328	336	344	352	360	368	376	384	392	1	2	2	3	4	5	6	6	7
542	400	408	416	424	432	440	448	456	464	472	1	2	2	3	4	5	6	6	7
543	480	488	496	504	512	520	528	536	544	552	1	2	2	3	4	5	6	6	7
544	560	568	576	584	592	600	608	616	624	632	1	2	2	3	4	5	6	6	7
545	640	648	656	664	672	679	687	695	703	711	1	2	2	3	4	5	6	6	7
546	719	727	735	743	751	759	767	775	783	791	1	2	2	3	4	5	6	6	7
547	799	807	815	823	830	838	846	854	862	870	1	2	2	3	4	5	6	6	7
548	878	886	894	902	910	918	926	933	941	949	1	2	2	3	4	5	6	6	7
549	957	965	973	981	989	997	*005*	*013*	*020*	*028*	1	2	2	3	4	5	6	6	7
550	74036	044	052	060	068	076	084	092	099	107	1	2	2	3	4	5	6	6	7
551	115	123	131	139	147	155	162	170	178	186	1	2	2	3	4	5	6	6	7
552	194	202	210	218	225	233	241	249	257	265	1	2	2	3	4	5	6	6	7
553	273	280	288	296	304	312	320	327	335	343	1	2	2	3	4	5	5	6	7
554	351	359	367	374	382	390	398	406	414	421	1	2	2	3	4	5	5	6	7
555	429	437	445	453	461	468	476	484	492	500	1	2	2	3	4	5	5	6	7
556	507	515	523	531	539	547	554	562	570	578	1	2	2	3	4	5	5	6	7
557	586	593	601	609	617	624	632	640	648	656	1	2	2	3	4	5	5	6	7
558	663	671	679	687	695	702	710	718	726	733	1	2	2	3	4	5	5	6	7
559	741	749	757	764	772	780	788	796	803	811	1	2	2	3	4	5	5	6	7
560	819	827	834	842	850	858	865	873	881	889	1	2	2	3	4	5	5	6	7
561	896	904	912	920	927	935	943	950	958	966	1	2	2	3	4	5	5	6	7
562	974	981	989	997	*005*	*012*	*020*	*028*	*035*	*043*	1	2	2	3	4	5	5	6	7
563	75051	059	066	074	082	089	097	105	113	120	1	2	2	3	4	5	5	6	7
564	128	136	143	151	159	166	174	182	189	197	1	2	2	3	4	5	5	6	7
565	205	213	220	228	236	243	251	259	266	274	1	2	2	3	4	5	5	6	7
566	282	289	297	305	312	320	328	336	343	351	1	2	2	3	4	5	5	6	7
567	358	366	374	381	389	397	404	412	420	427	1	2	2	3	4	5	5	6	7
568	435	442	450	458	465	473	481	488	496	504	1	2	2	3	4	5	5	6	7
569	511	519	526	534	542	549	557	565	572	580	1	2	2	3	4	5	5	6	7
570	587	595	603	610	618	626	633	641	648	656	1	2	2	3	4	5	5	6	7
571	664	671	679	686	694	702	709	717	724	732	1	2	2	3	4	5	5	6	7
572	740	747	755	762	770	778	785	793	800	808	1	2	2	3	4	5	5	6	7
573	815	823	831	838	846	853	861	868	876	884	1	2	2	3	4	5	5	6	7
574	891	899	906	914	921	929	937	944	952	959	1	2	2	3	4	5	5	6	7
575	967	974	982	989	997	*005*	*012*	*020*	*027*	*035*	1	2	2	3	4	5	5	6	7
576	76042	050	057	065	072	080	087	095	103	110	1	2	2	3	4	5	5	6	7
577	118	125	133	140	148	155	163	170	178	185	1	2	2	3	4	5	5	6	7
578	193	200	208	215	223	230	238	245	253	260	1	2	2	3	4	5	5	6	7
579	268	275	283	290	298	305	313	320	328	335	1	2	2	3	4	5	5	6	7

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580	76343	350	358	365	373	380	388	395	403	410	1	2	2	3	4	4	5	6	7
581	418	425	433	440	448	455	462	470	477	485	1	2	2	3	4	4	5	6	7
582	492	500	507	515	522	530	537	544	552	559	1	1	2	3	4	4	5	6	7
583	567	574	582	589	597	604	612	619	626	634	1	1	2	3	4	4	5	6	7
584	641	649	656	664	671	678	686	693	701	708	1	1	2	3	4	4	5	6	7
585	716	723	730	738	745	753	760	768	775	782	1	1	2	3	4	4	5	6	7
586	790	797	805	812	819	827	834	842	849	856	1	1	2	3	4	4	5	6	7
587	864	871	879	886	893	901	908	916	923	930	1	1	2	3	4	4	5	6	7
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676	995	*001*	*008*	*014*	*020*	*027*	*033*	*040*	*046*	*052*	1	1	2	3	3	4	4	5	6
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771	705	711	717	722	728	734	739	745	750	756	1	1	2	2	3	3	4	5	5
772	762	767	773	779	784	790	795	801	807	812	1	1	2	2	3	3	4	4	5
773	818	824	829	835	840	846	852	857	863	868	1	1	2	2	3	3	4	4	5
774	874	880	885	891	897	902	908	913	919	925	1	1	2	2	3	3	4	4	5
775	930	936	941	947	953	958	964	969	975	981	1	1	2	2	3	3	4	4	5
776	986	992	997	*003*	*009*	*014*	*020*	*025*	*031*	*037*	1	1	2	2	3	3	4	4	5
777	89042	048	053	059	064	070	076	081	087	092	1	1	2	2	3	3	4	4	5
778	098	104	109	115	120	126	131	137	143	148	1	1	2	2	3	3	4	4	5
779	154	159	165	170	176	182	187	193	198	204	1	1	2	2	3	3	4	4	5

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
780	89209	215	221	226	232	237	243	248	254	260	1	1	2	2	3	3	4	4	5
781	265	271	276	282	287	293	298	304	310	315	1	1	2	2	3	3	4	4	5
782	321	326	332	337	343	348	354	360	365	371	1	1	2	2	3	3	4	4	5
783	376	382	387	393	398	404	409	415	421	426	1	1	2	2	3	3	4	4	5
784	432	437	443	448	454	459	465	470	476	481	1	1	2	2	3	3	4	4	5
785	487	493	498	504	509	515	520	526	531	537	1	1	2	2	3	3	4	4	5
786	542	548	553	559	564	570	575	581	586	592	1	1	2	2	3	3	4	4	5
787	597	603	609	614	620	625	631	636	642	647	1	1	2	2	3	3	4	4	5
788	653	658	664	669	675	680	686	691	697	702	1	1	2	2	3	3	4	4	5
789	708	713	719	724	730	735	741	746	752	757	1	1	2	2	3	3	4	4	5
790	763	768	774	779	785	790	796	801	807	812	1	1	2	2	3	3	4	4	5
791	818	823	829	834	840	845	851	856	862	867	1	1	2	2	3	3	4	4	5
792	873	878	883	889	894	900	905	911	916	922	1	1	2	2	3	3	4	4	5
793	927	933	938	944	949	955	960	966	971	977	1	1	2	2	3	3	4	4	5
794	982	988	993	998	*004*	*009*	*015*	*020*	*026*	*031*	1	1	2	2	3	3	4	4	5
795	90037	042	048	053	059	064	069	075	080	086	1	1	2	2	3	3	4	4	5
796	091	097	102	108	113	119	124	129	135	140	1	1	2	2	3	3	4	4	5
797	146	151	157	162	168	173	179	184	189	195	1	1	2	2	3	3	4	4	5
798	200	206	211	217	222	227	233	238	244	249	1	1	2	2	3	3	4	4	5
799	255	260	266	271	276	282	287	293	298	304	1	1	2	2	3	3	4	4	5
800	309	314	320	325	331	336	342	347	352	358	1	1	2	2	3	3	4	4	5
801	363	369	374	380	385	390	396	401	407	412	1	1	2	2	3	3	4	4	5
802	417	423	428	434	439	444	450	455	461	466	1	1	2	2	3	3	4	4	5
803	472	477	482	488	493	499	504	509	515	520	1	1	2	2	3	3	4	4	5
804	526	531	536	542	547	553	558	563	569	574	1	1	2	2	3	3	4	4	5
805	580	585	590	596	601	607	612	617	623	628	1	1	2	2	3	3	4	4	5
806	634	639	644	650	655	660	666	671	677	682	1	1	2	2	3	3	4	4	5
807	687	693	698	704	709	714	720	725	730	736	1	1	2	2	3	3	4	4	5
808	741	747	752	757	763	768	773	779	784	789	1	1	2	2	3	3	4	4	5
809	795	800	806	811	816	822	827	832	838	843	1	1	2	2	3	3	4	4	5
810	849	854	859	865	870	875	881	886	891	897	1	1	2	2	3	3	4	4	5
811	902	907	913	918	924	929	934	940	945	950	1	1	2	2	3	3	4	4	5
812	956	961	966	972	977	982	988	993	998	*004*	1	1	2	2	3	3	4	4	5
813	91009	014	020	025	030	036	041	046	052	057	1	1	2	2	3	3	4	4	5
814	062	068	073	078	084	089	094	100	105	110	1	1	2	2	3	3	4	4	5
815	116	121	126	132	137	142	148	153	158	164	1	1	2	2	3	3	4	4	5
816	169	174	180	185	190	196	201	206	212	217	1	1	2	2	3	3	4	4	5
817	222	228	233	238	243	249	254	259	265	270	1	1	2	2	3	3	4	4	5
818	275	281	286	291	297	302	307	312	318	323	1	1	2	2	3	3	4	4	5
819	328	334	339	344	350	355	360	365	371	376	1	1	2	2	3	3	4	4	5

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
820	91381	387	392	397	403	408	413	418	424	429	1	1	2	2	3	3	4	4	5
821	434	440	445	450	455	461	466	471	477	482	1	1	2	2	3	3	4	4	5
822	487	492	498	503	508	514	519	524	529	535	1	1	2	2	3	3	4	4	5
823	540	545	551	556	561	566	572	577	582	587	1	1	2	2	3	3	4	4	5
824	593	598	603	609	614	619	624	630	635	640	1	1	2	2	3	3	4	4	5
825	645	651	656	661	666	672	677	682	687	693	1	1	2	2	3	3	4	4	5
826	698	703	709	714	719	724	730	735	740	745	1	1	2	2	3	3	4	4	5
827	751	756	761	766	772	777	782	787	793	798	1	1	2	2	3	3	4	4	5
828	803	808	814	819	824	829	834	840	845	850	1	1	2	2	3	3	4	4	5
829	855	861	866	871	876	882	887	892	897	903	1	1	2	2	3	3	4	4	5
830	908	913	918	924	929	934	939	944	950	955	1	1	2	2	3	3	4	4	5
831	960	965	971	976	981	986	991	997	*002*	*007*	1	1	2	2	3	3	4	4	5
832	92012	018	023	028	033	038	044	049	054	059	1	1	2	2	3	3	4	4	5
833	065	070	075	080	085	091	096	101	106	111	1	1	2	2	3	3	4	4	5
834	117	122	127	132	137	143	148	153	158	163	1	1	2	2	3	3	4	4	5
835	169	174	179	184	189	195	200	205	210	215	1	1	2	2	3	3	4	4	5
836	221	226	231	236	241	247	252	257	262	267	1	1	2	2	3	3	4	4	5
837	273	278	283	288	293	298	304	309	314	319	1	1	2	2	3	3	4	4	5
838	324	330	335	340	345	350	355	361	366	371	1	1	2	2	3	3	4	4	5
839	376	381	387	392	397	402	407	412	418	423	1	1	2	2	3	3	4	4	5
840	428	433	438	443	449	454	459	464	469	474	1	1	2	2	3	3	4	4	5
841	480	485	490	495	500	505	511	516	521	526	1	1	2	2	3	3	4	4	5
842	531	536	542	547	552	557	562	567	572	578	1	1	2	2	3	3	4	4	5
843	583	588	593	598	603	609	614	619	624	629	1	1	2	2	3	3	4	4	5
844	634	639	645	650	655	660	665	670	675	681	1	1	2	2	3	3	4	4	5
845	686	691	696	701	706	711	716	722	727	732	1	1	2	2	3	3	4	4	5
846	737	742	747	752	758	763	768	773	778	783	1	1	2	2	3	3	4	4	5
847	788	793	799	804	809	814	819	824	829	834	1	1	2	2	3	3	4	4	5
848	840	845	850	855	860	865	870	875	881	886	1	1	2	2	3	3	4	4	5
849	891	896	901	906	911	916	921	927	932	937	1	1	2	2	3	3	4	4	5
850	942	947	952	957	962	967	973	978	983	988	1	1	2	2	3	3	4	4	5
851	993	998	*003*	*008*	*013*	*018*	*024*	*029*	*034*	*039*	1	1	2	2	3	3	4	4	5
852	93044	049	054	059	064	069	075	080	085	090	1	1	2	2	3	3	4	4	5
853	095	100	105	110	115	120	125	131	136	141	1	1	2	2	3	3	4	4	5
854	146	151	156	161	166	171	176	181	186	192	0	1	2	2	3	3	4	4	5
855	197	202	207	212	217	222	227	232	237	242	0	1	2	2	3	3	4	4	5
856	247	252	258	263	268	273	278	283	288	293	0	1	2	2	3	3	4	4	5
857	298	303	308	313	318	323	328	334	339	344	0	1	2	2	3	3	4	4	5
858	349	354	359	364	369	374	379	384	389	394	0	1	2	2	3	3	4	4	5
859	399	404	409	414	420	425	430	435	440	445	0	1	2	2	3	3	4	4	5

860] Five-figure Logarithms—*continued.* [·93

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
860	93450	455	460	465	470	475	480	485	490	495	0	1	2	2	3	3	4	4	5
861	500	505	510	515	520	526	531	536	541	546	0	1	2	2	3	3	4	4	5
862	551	556	561	566	571	576	581	586	591	596	0	1	2	2	3	3	4	4	5
863	601	606	611	616	621	626	631	636	641	646	0	1	2	2	3	3	4	4	5
864	651	656	661	666	671	676	682	687	692	697	0	1	2	2	3	3	4	4	5
865	702	707	712	717	722	727	732	737	742	747	0	1	2	2	3	3	4	4	5
866	752	757	762	767	772	777	782	787	792	797	0	1	2	2	2	3	4	4	5
867	802	807	812	817	822	827	832	837	842	847	0	1	2	2	2	3	4	4	4
868	852	857	862	867	872	877	882	887	892	897	0	1	2	2	2	3	4	4	4
869	902	907	912	917	922	927	932	937	942	947	0	1	2	2	2	3	3	4	4
870	952	957	962	967	972	977	982	987	992	997	0	1	1	2	2	3	3	4	4
871	94002	007	012	017	022	027	032	037	042	047	0	1	1	2	2	3	3	4	4
872	052	057	062	067	072	077	082	086	091	096	0	1	1	2	2	3	3	4	4
873	101	106	111	116	121	126	131	136	141	146	0	1	1	2	2	3	3	4	4
874	151	156	161	166	171	176	181	186	191	196	0	1	1	2	2	3	3	4	4
875	201	206	211	216	221	226	231	236	240	245	0	1	1	2	2	3	3	4	4
876	250	255	260	265	270	275	280	285	290	295	0	1	1	2	2	3	3	4	4
877	300	305	310	315	320	325	330	335	340	344	0	1	1	2	2	3	3	4	4
878	349	354	359	364	369	374	379	384	389	394	0	1	1	2	2	3	3	4	4
879	399	404	409	414	419	424	429	433	438	443	0	1	1	2	2	3	3	4	4
880	448	453	458	463	468	473	478	483	488	493	0	1	1	2	2	3	3	4	4
881	498	503	507	512	517	522	527	532	537	542	0	1	1	2	2	3	3	4	4
882	547	552	557	562	567	571	576	581	586	591	0	1	1	2	2	3	3	4	4
883	596	601	606	611	616	621	626	630	635	640	0	1	1	2	2	3	3	4	4
884	645	650	655	660	665	670	675	680	685	689	0	1	1	2	2	3	3	4	4
885	694	699	704	709	714	719	724	729	734	738	0	1	1	2	2	3	3	4	4
886	743	748	753	758	763	768	773	778	783	787	0	1	1	2	2	3	3	4	4
887	792	797	802	807	812	817	822	827	832	836	0	1	1	2	2	3	3	4	4
888	841	846	851	856	861	866	871	876	880	885	0	1	1	2	2	3	3	4	4
889	890	895	900	905	910	915	919	924	929	934	0	1	1	2	2	3	3	4	4
890	939	944	949	954	959	963	968	973	978	983	0	1	1	2	2	3	3	4	4
891	988	993	998	*002*	*007*	*012*	*017*	*022*	*027*	*032*	0	1	1	2	2	3	3	4	4
892	95036	041	046	051	056	061	066	071	075	080	0	1	1	2	2	3	3	4	4
893	085	090	095	100	105	109	114	119	124	129	0	1	1	2	2	3	3	4	4
894	134	139	143	148	153	158	163	168	173	177	0	1	1	2	2	3	3	4	4
895	182	187	192	197	202	207	211	216	221	226	0	1	1	2	2	3	3	4	4
896	231	236	240	245	250	255	260	265	270	274	0	1	1	2	2	3	3	4	4
897	279	284	289	294	299	303	308	313	318	323	0	1	1	2	2	3	3	4	4
898	328	332	337	342	347	352	357	361	366	371	0	1	1	2	2	3	3	4	4
899	376	381	386	390	395	400	405	410	415	419	0	1	1	2	2	3	3	4	4

900] Five-figure Logarithms—*continued.* [·95

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
900	95424	429	434	439	444	448	453	458	463	468	0	1	1	2	2	3	3	4	4
901	472	477	482	487	492	497	501	506	511	516	0	1	1	2	2	3	3	4	4
902	521	525	530	535	540	545	550	554	559	564	0	1	1	2	2	3	3	4	4
903	569	574	578	583	588	593	598	602	607	612	0	1	1	2	2	3	3	4	4
904	617	622	626	631	636	641	646	650	655	660	0	1	1	2	2	3	3	4	4
905	665	670	674	679	684	689	694	698	703	708	0	1	1	2	2	3	3	4	4
906	713	718	722	727	732	737	742	746	751	756	0	1	1	2	2	3	3	4	4
907	761	766	770	775	780	785	789	794	799	804	0	1	1	2	2	3	3	4	4
908	809	813	818	823	828	832	837	842	847	852	0	1	1	2	2	3	3	4	4
909	856	861	866	871	875	880	885	890	895	899	0	1	1	2	2	3	3	4	4
910	904	909	914	918	923	928	933	938	942	947	0	1	1	2	2	3	3	4	4
911	952	957	961	966	971	976	980	985	990	995	0	1	1	2	2	3	3	4	4
912	999	*004*	*009*	*014*	*019*	*023*	*028*	*033*	*038*	*042*	0	1	1	2	2	3	3	4	4
913	96047	052	057	061	066	071	076	080	085	090	0	1	1	2	2	3	3	4	4
914	095	099	104	109	114	118	123	128	133	137	0	1	1	2	2	3	3	4	4
915	142	147	152	156	161	166	171	175	180	185	0	1	1	2	2	3	3	4	4
916	190	194	199	204	209	213	218	223	227	232	0	1	1	2	2	3	3	4	4
917	237	242	246	251	256	261	265	270	275	280	0	1	1	2	2	3	3	4	4
918	284	289	294	298	303	308	313	317	322	327	0	1	1	2	2	3	3	4	4
919	332	336	341	346	350	355	360	365	369	374	0	1	1	2	2	3	3	4	4
920	379	384	388	393	398	402	407	412	417	421	0	1	1	2	2	3	3	4	4
921	426	431	435	440	445	450	454	459	464	468	0	1	1	2	2	3	3	4	4
922	473	478	483	487	492	497	501	506	511	515	0	1	1	2	2	3	3	4	4
923	520	525	530	534	539	544	548	553	558	562	0	1	1	2	2	3	3	4	4
924	567	572	577	581	586	591	595	600	605	609	0	1	1	2	2	3	3	4	4
925	614	619	624	628	633	638	642	647	652	656	0	1	1	2	2	3	3	4	4
926	661	666	670	675	680	685	689	694	699	703	0	1	1	2	2	3	3	4	4
927	708	713	717	722	727	731	736	741	745	750	0	1	1	2	2	3	3	4	4
928	755	759	764	769	774	778	783	788	792	797	0	1	1	2	2	3	3	4	4
929	802	806	811	816	820	825	830	834	839	844	0	1	1	2	2	3	3	4	4
930	848	853	858	862	867	872	876	881	886	890	0	1	1	2	2	3	3	4	4
931	895	900	904	909	914	918	923	928	932	937	0	1	1	2	2	3	3	4	4
932	942	946	951	956	960	965	970	974	979	984	0	1	1	2	2	3	3	4	4
933	988	993	997	*002*	*007*	*011*	*016*	*021*	*025*	*030*	0	1	1	2	2	3	3	4	4
934	97035	039	044	049	053	058	063	067	072	077	0	1	1	2	2	3	3	4	4
935	081	086	090	095	100	104	109	114	118	123	0	1	1	2	2	3	3	4	4
936	128	132	137	142	146	151	155	160	165	169	0	1	1	2	2	3	3	4	4
937	174	179	183	188	192	197	202	206	211	216	0	1	1	2	2	3	3	4	4
938	220	225	230	234	239	243	248	253	257	262	0	1	1	2	2	3	3	4	4
939	267	271	276	280	285	290	294	299	304	308	0	1	1	2	2	3	3	4	4

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
940	97313	317	322	327	331	336	340	345	350	354	0	1	1	2	2	3	3	4	4
941	359	364	368	373	377	382	387	391	396	400	0	1	1	2	2	3	3	4	4
942	405	410	414	419	424	428	433	437	442	447	0	1	1	2	2	3	3	4	4
943	451	456	460	465	470	474	479	483	488	493	0	1	1	2	2	3	3	4	4
944	497	502	506	511	516	520	525	529	534	539	0	1	1	2	2	3	3	4	4
945	543	548	552	557	562	566	571	575	580	585	0	1	1	2	2	3	3	4	4
946	589	594	598	603	607	612	617	621	626	630	0	1	1	2	2	3	3	4	4
947	635	640	644	649	653	658	663	667	672	676	0	1	1	2	2	3	3	4	4
948	681	685	690	695	699	704	708	713	717	722	0	1	1	2	2	3	3	4	4
949	727	731	736	740	745	750	754	759	763	768	0	1	1	2	2	3	3	4	4
950	772	777	782	786	791	795	800	804	809	813	0	1	1	2	2	3	3	4	4
951	818	823	827	832	836	841	845	850	855	859	0	1	1	2	2	3	3	4	4
952	864	868	873	877	882	886	891	896	900	905	0	1	1	2	2	3	3	4	4
953	909	914	918	923	928	932	937	941	946	950	0	1	1	2	2	3	3	4	4
954	955	959	964	968	973	978	982	987	991	996	0	1	1	2	2	3	3	4	4
955	98000	005	009	014	019	023	028	032	037	041	0	1	1	2	2	3	3	4	4
956	046	050	055	059	064	068	073	078	082	087	0	1	1	2	2	3	3	4	4
957	091	096	100	105	109	114	118	123	127	132	0	1	1	2	2	3	3	4	4
958	137	141	146	150	155	159	164	168	173	177	0	1	1	2	2	3	3	4	4
959	182	186	191	195	200	204	209	214	218	223	0	1	1	2	2	3	3	4	4
960	227	232	236	241	245	250	254	259	263	268	0	1	1	2	2	3	3	4	4
961	272	277	281	286	290	295	299	304	308	313	0	1	1	2	2	3	3	4	4
962	318	322	327	331	336	340	345	349	354	358	0	1	1	2	2	3	3	4	4
963	363	367	372	376	381	385	390	394	399	403	0	1	1	2	2	3	3	4	4
964	408	412	417	421	426	430	435	439	444	448	0	1	1	2	2	3	3	4	4
965	453	457	462	466	471	475	480	484	489	493	0	1	1	2	2	3	3	4	4
966	498	502	507	511	516	520	525	529	534	538	0	1	1	2	2	3	3	4	4
967	543	547	552	556	561	565	570	574	579	583	0	1	1	2	2	3	3	4	4
968	588	592	597	601	605	610	614	619	623	628	0	1	1	2	2	3	3	4	4
969	632	637	641	646	650	655	659	664	668	673	0	1	1	2	2	3	3	4	4
970	677	682	686	691	695	700	704	709	713	717	0	1	1	2	2	3	3	4	4
971	722	726	731	735	740	744	749	753	758	762	0	1	1	2	2	3	3	4	4
972	767	771	776	780	784	789	793	798	802	807	0	1	1	2	2	3	3	4	4
973	811	816	820	825	829	834	838	843	847	851	0	1	1	2	2	3	3	4	4
974	856	860	865	869	874	878	883	887	892	896	0	1	1	2	2	3	3	4	4
975	900	905	909	914	918	923	927	932	936	941	0	1	1	2	2	3	3	4	4
976	945	949	954	958	963	967	972	976	981	985	0	1	1	2	2	3	3	4	4
977	989	994	998	*003*	*007*	*012*	*016*	*021*	*025*	*029*	0	1	1	2	2	3	3	4	4
978	99034	038	043	047	052	056	061	065	069	074	0	1	1	2	2	3	3	4	4
979	078	083	087	092	096	100	105	109	114	118	0	1	1	2	2	3	3	4	4

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
980	99123	127	131	136	140	145	149	154	158	162	0	1	1	2	2	3	3	4	4
981	167	171	176	180	185	189	193	198	202	207	0	1	1	2	2	3	3	4	4
982	211	216	220	224	229	233	238	242	247	251	0	1	1	2	2	3	3	4	4
983	255	260	264	269	273	277	282	286	291	295	0	1	1	2	2	3	3	4	4
984	300	304	308	313	317	322	326	330	335	339	0	1	1	2	2	3	3	4	4
985	344	348	352	357	361	366	370	374	379	383	0	1	1	2	2	3	3	4	4
986	388	392	396	401	405	410	414	419	423	427	0	1	1	2	2	3	3	4	4
987	432	436	441	445	449	454	458	463	467	471	0	1	1	2	2	3	3	4	4
988	476	480	484	489	493	498	502	506	511	515	0	1	1	2	2	3	3	4	4
989	520	524	528	533	537	542	546	550	555	559	0	1	1	2	2	3	3	4	4
990	564	568	572	577	581	585	590	594	599	603	0	1	1	2	2	3	3	4	4
991	607	612	616	621	625	629	634	638	642	647	0	1	1	2	2	3	3	4	4
992	651	656	660	664	669	673	677	682	686	691	0	1	1	2	2	3	3	4	4
993	695	699	704	708	712	717	721	726	730	734	0	1	1	2	2	3	3	3	4
994	739	743	747	752	756	760	765	769	774	778	0	1	1	2	2	3	3	3	4
995	782	787	791	795	800	804	808	813	817	822	0	1	1	2	2	3	3	3	4
996	826	830	835	839	843	848	852	856	861	865	0	1	1	2	2	3	3	3	4
997	870	874	878	883	887	891	896	900	904	909	0	1	1	2	2	3	3	3	4
998	913	917	922	926	930	935	939	944	948	952	0	1	1	2	2	3	3	3	4
999	957	961	965	970	974	978	983	987	991	996	0	1	1	2	2	3	3	3	4

Mathematical Constants and their Logarithms.

	Log.
π = 3·14159265 .... (=22/7 for all practical purposes)	0·49715
$180/\pi$ = 57.296° = radian in degrees	1·75813
e = 2·71828	0·43429

To convert common to Napierian logarithms, multiply by $\log_e 10$ = 2·302585, or exponential (2·302585) = 10.

Mechanical Constants and their Logarithms.

		Log.
g = 32·2 ft. per sec.^{2}		1·50786
= 981 cm. per sec.^{2}		2·99167

(Actual figures : London, 32·19078; Paris, 32·18255; New York, 32·15945 ft. per sec.^{2})

		Log.
1 lb. weight	= 4·45 × 10^5 dynes	5·64836
1 ft.-lb.	= 1·356 × 10^7 ergs	7·13226
10^6 dynes	= 2·247 lb. weight	0·35160
10^8 ergs	= 7·371 ft.-lb.	0·86753
1 atmosphere	= 14·7 lb. weight per sq. in.	1·16732
	= 1·014 × 10^6 dynes per sq. cm.	6·00604
1 horse-power	= 33000 ft.-lb. per min.	4·51851
Mechanical equivalent of heat, J = 426·9 calories		2·63033
1 B. Th. U.	= 0·252 Calorie (K)	$\bar{1}$·40140
	= 252 calories	2·40140
	= 778 ft. lbs.	2·89098
1 (large) Calorie	= 3·968 B. Th. U.	0·59857
1 H.P.	= 0·707 B. Th. U. per sec.	$\bar{1}$·84942
	= 0·178 Calorie per sec.	$\bar{1}$·25042
	= 0·746 Kilowatt.	$\bar{1}$·87274
1 Kilowatt	= 0·949 B. Th. U. per sec.	$\bar{1}$·97727
	= 0·239 Calorie per sec.	$\bar{1}$·37840
	= 738 ft.-lbs. per sec.	2·86806
	= 1·341 H.P.	0·12743

Conversion of Pounds per sq. inch to Kilograms per sq. cm.

1 lb. per sq. in. = 0.070310 kgm. per sq. cm.

	0	1	2	3	4	5	6	7	8	9
0		0.0703	0.1406	0.2109	0.2812	0.3516	0.4219	0.4922	0.5625	0.6328
10	0.7031	0.7734	0.8437	0.9140	0.9843	1.0546	1.1250	1.1953	1.2656	1.3359
20	1.4062	1.4765	1.5468	1.6171	1.6874	1.7577	1.8280	1.8984	1.9687	2.0390
30	2.1093	2.1796	2.2499	2.3202	2.3905	2.4608	2.5311	2.6015	2.6718	2.7421
40	2.8124	2.8827	2.9530	3.0233	3.0936	3.1639	2.2342	3.3045	3.3749	3.4452
50	3.5155	3.5858	3.6561	3.7264	3.7967	3.8670	3.9373	4.0076	4.0780	4.1483
60	4.2186	4.2889	4.3592	4.4295	4.4998	4.5701	4.6404	4.7107	4.7810	4.8514
70	4.9217	4.9920	5.0623	5.1326	5.2029	5.2732	5.3435	5.4138	5.4841	5.5545
80	5.6248	5.6951	5.7654	5.8357	5.9060	5.9763	6.0466	6.1169	6.1872	6.2575
90	6.3279	6.3982	6.4685	6.5388	6.6091	6.6794	6.7497	6.8200	6.8903	6.9606
100	7.0310	7.1013	7.1716	7.2419	7.3122	7.3825	7.4528	7.5231	7.5934	7.6637

Mensuration Formulæ.

Triangle. Area $= \frac{1}{2}$ (base $\times$ height), or $= \sqrt{s(s-a)(s-b)(s-c)}$, where $s = \frac{1}{2}(a+b+c)$.

Parallelogram. Area = base $\times$ height.

Simpson's rule. Area $= \frac{l}{3}(A + 4B + 2C)$,

where l = space between two consecutive ordinates:
A = sum of first and last ordinates;
B = sum of the even ordinates;
and C = sum of the odd ordinates.

Circle. Circumference $= 2\pi r$.

Area $= \pi r^2$ or $\frac{\pi d^2}{4}$

Annular ring. Area $= \pi(R^2 - r^2)$.

Ellipse. Area $= \frac{\pi}{4}$ (product of axes).

Cylinder. Surface $= 2\pi r h + 2\pi r^2$.
Volume $= \pi r^2 h$.

Prism. Surface $= 2(ab + bc + ca)$.
Volume $= abc$.
Diagonal $= \sqrt{a^2 + b^2 + c^2}$.

Sphere. Surface $= 4\pi r^2$.
Volume $= \frac{4}{3}\pi r^3$.

Cone. Curved surface $= 4\pi r \times$ slant height $= \pi r\sqrt{r^2 + h^2}$.
Volume $= \frac{\pi}{3} r^2 h$.

Frustum of cone. Surface $= \pi(R + r) \times$ slant height.
Volume $= \frac{\pi h}{3}(R^2 + r^2 + R r)$.

Pyramid. Volume $= \frac{1}{3}$ (area of base $\times h$).

Trigonometrical Formulæ.

$$\sin a = \frac{\text{opposite}}{\text{hypotenuse}}; \quad \cos a = \frac{\text{adjacent}}{\text{hypotenuse}}$$

$$\sin a = \sin(180^\circ - a) = \cos(90^\circ - a)$$

$$\cos(180^\circ - a) = -\cos a.$$

$$\tan a = \frac{\text{opposite}}{\text{adjacent}}$$

In triangle ABC: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$.

Area $= \frac{1}{2} bc \sin A$

Powers of Numbers, Areas, &c.

n	n^2	n^3	$\sqrt{n}$	$\frac{1}{n}$	πn	$\frac{\pi n^2}{4}$
1	1	1	1.0000	1.000000	3.142	0.7854
2	4	8	1.4142	0.500000	6.283	3.1416
3	9	27	1.7320	0.333333	9.425	7.0686
4	16	64	2.0000	0.250000	12.566	12.566
5	25	125	2.2361	0.200000	15.708	19.635
6	36	216	2.4495	0.166667	18.850	28.274
7	49	343	2.6458	0.142857	21.991	38.486
8	64	512	2.8284	0.125000	25.133	50.265
9	81	729	3.0000	0.111111	28.274	63.617
10	100	1000	3.1623	0.100000	31.416	78.540
11	121	1331	3.3166	0.090909	34.558	95.033
12	144	1728	3.4641	0.083333	37.699	113.10
13	169	2197	3.6056	0.076923	40.841	132.73
14	196	2744	3.7417	0.071429	43.982	153.94
15	225	3375	3.8730	0.066667	47.124	176.72
16	256	4096	4.0000	0.062500	50.265	201.06
17	289	4913	4.1231	0.058824	53.407	226.98
18	324	5832	4.2426	0.055556	56.549	254.47
19	361	6859	4.3589	0.052632	59.690	283.53
20	400	8000	4.4721	0.050000	62.832	314.16
21	441	9261	4.5826	0.047619	65.973	346.36
22	484	10648	4.6904	0.045455	69.115	380.13
23	529	12167	4.7958	0.043478	72.257	415.48
24	576	13824	4.8990	0.041667	75.398	452.39
25	625	15625	5.0000	0.040000	78.540	490.88
26	676	17576	5.0990	0.038462	81.681	530.93
27	729	19683	5.1962	0.037037	84.823	572.56
28	784	21952	5.2915	0.035714	87.965	615.75
29	841	24389	5.3852	0.034483	91.106	660.52
30	900	27000	5.4772	0.033333	94.248	706.86
31	961	29791	5.5678	0.032258	97.389	754.77
32	1024	32768	5.6568	0.031250	100.53	804.25
33	1089	35937	5.7446	0.030303	103.67	855.30
34	1156	39304	5.8310	0.029412	106.81	907.92
35	1225	42875	5.9161	0.028571	109.96	962.12
36	1296	46656	6.0000	0.027778	113.10	1017.88
37	1369	50653	6.0828	0.027027	116.24	1075.21
38	1444	54872	6.1644	0.026316	119.38	1134.11
39	1521	59319	6.2450	0.025641	122.52	1194.59
40	1600	64000	6.3246	0.025000	125.66	1256.64
41	1681	68921	6.4031	0.024390	128.81	1320.25
42	1764	74088	6.4807	0.023810	131.95	1385.44
43	1849	79507	6.5574	0.023256	135.09	1452.20
44	1936	85184	6.6332	0.022727	138.23	1520.53
45	2025	91125	6.7082	0.022222	141.37	1590.43
46	2116	97336	6.7823	0.021739	144.51	1661.90
47	2209	103823	6.8556	0.021277	147.65	1734.94
48	2304	110592	6.9282	0.020833	150.80	1809.56
49	2401	117649	7.0000	0.020408	153.94	1885.74

n	n^2	n^3	$\sqrt{n}$	$\frac{1}{n}$	πn	$\frac{\pi n^2}{4}$
50	2500	125000	7.0711	0.020000	157.08	1963.50
51	2601	132651	7.1414	0.019608	160.22	2042.82
52	2704	140608	7.2111	0.019231	163.36	2123.72
53	2809	148877	7.2801	0.018868	166.50	2206.19
54	2916	157464	7.3485	0.018519	169.64	2290.22
55	3025	166375	7.4162	0.018182	172.78	2375.83
56	3136	175616	7.4833	0.017857	175.93	2463.01
57	3249	185193	7.5498	0.017544	179.07	2551.76
58	3364	195112	7.6158	0.017241	182.21	2642.08
59	3481	205379	7.6812	0.016949	185.35	2733.97
60	3600	216000	7.7460	0.016667	188.49	2827.44
61	3721	226981	7.8102	0.016393	191.63	2922.47
62	3844	238328	7.8740	0.016129	194.77	3019.07
63	3969	250047	7.9372	0.015873	197.92	3117.25
64	4096	262144	8.0000	0.015625	201.06	3216.99
65	4225	274625	8.0623	0.015385	204.20	3318.31
66	4356	287496	8.1240	0.015152	207.34	3421.20
67	4489	300763	8.1854	0.014925	210.48	3525.66
68	4624	314432	8.2462	0.014706	213.63	3631.69
69	4761	328509	8.3066	0.014493	216.77	3739.29
70	4900	343000	8.3666	0.014286	219.91	3848.46
71	5041	357911	8.4262	0.014085	223.05	3959.20
72	5184	373248	8.4853	0.013889	226.19	4071.51
73	5329	389017	8.5440	0.013699	229.33	4185.39
74	5476	405224	8.6023	0.013514	232.47	4300.85
75	5625	421875	8.6602	0.013333	235.62	4417.87
76	5776	438976	8.7178	0.013158	238.76	4536.47
77	5929	456533	8.7750	0.012987	241.90	4656.63
78	6084	474552	8.8318	0.012821	245.04	4778.37
79	6241	493039	8.8882	0.012658	248.18	4901.68
80	6400	512000	8.9443	0.012500	251.32	5026.56
81	6561	531441	9.0000	0.012346	254.47	5153.01
82	6724	551368	9.0554	0.012195	257.61	5281.03
83	6889	571787	9.1104	0.012048	260.75	5410.62
84	7056	592704	9.1652	0.011905	263.89	5541.78
85	7225	614125	9.2195	0.011765	267.03	5674.50
86	7396	636056	9.2736	0.011628	270.17	5808.81
87	7569	658503	9.3274	0.011494	273.32	5944.69
88	7744	681472	9.3808	0.011364	276.46	6082.13
89	7921	704969	9.4340	0.011236	279.60	6221.13
90	8100	729000	9.4868	0.011111	282.74	6361.74
91	8281	753571	9.5394	0.010989	285.88	6503.89
92	8464	778688	9.5917	0.010870	289.02	6647.62
93	8649	804357	9.6436	0.010753	292.17	6792.92
94	8836	830584	9.6954	0.010638	295.31	6939.78
95	9025	857375	9.7468	0.010526	298.46	7088.23
96	9216	884736	9.7980	0.010417	301.59	7238.24
97	9409	912673	9.8489	0.010309	304.73	7389.83
98	9604	941192	9.8995	0.010204	307.87	7542.98
99	9801	970299	9.9499	0.010101	311.02	7697.68
100	10000	1000000	10.0000	0.010000	314.16	7854.00

Approx. Formulæ: $\sqrt{a^2 \pm b} = a \pm \frac{b}{2a}$ and $\sqrt[3]{a^3 \pm b} = a \pm \frac{b}{3a^2}$

Natural Sines. Natural Tangents.

	Natural Sines.						Natural Tangents.					
	0′	10′	20′	30′	40′	50′	0′	10′	20′	30′	40′	50′
0°	·0000	·0029	·0058	·0087	·0116	·0145	·0000	·0029	·0058	·0087	·0116	·0145
1	·0175	·0204	·0233	·0262	·0291	·0320	·0175	·0204	·0233	·0262	·0291	·0320
2	·0349	·0378	·0407	·0436	·0465	·0494	·0349	·0378	·0407	·0437	·0466	·0495
3	·0523	·0552	·0581	·0610	·0640	·0669	·0524	·0553	·0582	·0612	·0641	·0670
4	·0698	·0727	·0756	·0785	·0814	·0843	·0699	·0729	·0758	·0787	·0816	·0846
5	·0872	·0901	·0929	·0958	·0987	·1016	·0875	·0904	·0934	·0963	·0992	·1022
6	·1045	·1074	·1103	·1132	·1161	·1190	·1051	·1080	·1110	·1139	·1169	·1198
7	·1219	·1248	·1276	·1305	·1334	·1363	·1228	·1257	·1287	·1317	·1346	·1376
8	·1392	·1421	·1449	·1478	·1507	·1536	·1405	·1435	·1465	·1495	·1524	·1554
9	·1564	·1593	·1622	·1650	·1679	·1708	·1584	·1614	·1644	·1673	·1703	·1733
10	·1736	·1765	·1794	·1822	·1851	·1880	·1763	·1793	·1823	·1853	·1883	·1914
11	·1908	·1937	·1965	·1994	·2022	·2051	·1944	·1974	·2004	·2035	·2065	·2095
12	·2079	·2108	·2136	·2164	·2193	·2221	·2126	·2156	·2186	·2217	·2247	·2278
13	·2250	·2278	·2306	·2334	·2363	·2391	·2309	·2339	·2370	·2401	·2432	·2462
14	·2419	·2447	·2476	·2504	·2532	·2560	·2493	·2524	·2555	·2586	·2617	·2648
15	·2588	·2616	·2644	·2672	·2700	·2728	·2679	·2711	·2742	·2773	·2805	·2836
16	·2756	·2784	·2812	·2840	·2868	·2896	·2867	·2899	·2931	·2962	·2994	·3026
17	·2924	·2952	·2979	·3007	·3035	·3062	·3057	·3089	·3121	·3153	·3185	·3217
18	·3090	·3118	·3145	·3173	·3201	·3228	·3249	·3281	·3314	·3346	·3378	·3411
19	·3256	·3283	·3311	·3338	·3365	·3393	·3443	·3476	·3508	·3541	·3574	·3607
20	·3420	·3448	·3475	·3502	·3529	·3557	·3640	·3673	·3706	·3739	·3772	·3805
21	·3584	·3611	·3638	·3665	·3692	·3719	·3839	·3872	·3906	·3939	·3973	·4006
22	·3746	·3773	·3800	·3827	·3854	·3881	·4040	·4074	·4108	·4142	·4176	·4210
23	·3907	·3934	·3961	·3987	·4014	·4041	·4245	·4279	·4314	·4348	·4383	·4417
24	·4067	·4094	·4120	·4147	·4173	·4200	·4452	·4487	·4522	·4557	·4592	·4628
25	·4226	·4253	·4279	·4305	·4331	·4358	·4663	·4699	·4734	·4770	·4806	·4841
26	·4384	·4410	·4436	·4462	·4488	·4514	·4877	·4913	·4950	·4986	·5022	·5059
27	·4540	·4566	·4592	·4617	·4643	·4669	·5095	·5132	·5169	·5206	·5243	·5280
28	·4695	·4720	·4746	·4772	·4797	·4823	·5317	·5354	·5392	·5430	·5467	·5505
29	·4848	·4874	·4899	·4924	·4950	·4975	·5543	·5581	·5619	·5658	·5696	·5735
30	·5000	·5025	·5050	·5075	·5100	·5125	·5774	·5812	·5851	·5890	·5930	·5969
31	·5150	·5175	·5200	·5225	·5250	·5275	·6009	·6048	·6088	·6128	·6168	·6208
32	·5299	·5324	·5348	·5373	·5398	·5422	·6249	·6289	·6330	·6371	·6412	·6453
33	·5446	·5471	·5495	·5519	·5544	·5568	·6494	·6536	·6577	·6619	·6661	·6703
34	·5592	·5616	·5640	·5664	·5688	·5712	·6745	·6787	·6830	·6873	·6916	·6959
35	·5736	·5760	·5783	·5807	·5831	·5854	·7002	·7046	·7089	·7133	·7177	·7221
36	·5878	·5901	·5925	·5948	·5972	·5995	·7265	·7310	·7355	·7400	·7445	·7490
37	·6018	·6041	·6065	·6088	·6111	·6134	·7536	·7581	·7627	·7673	·7720	·7766
38	·6157	·6180	·6202	·6225	·6248	·6271	·7813	·7860	·7907	·7954	·8002	·8050
39	·6293	·6316	·6338	·6361	·6383	·6406	·8098	·8146	·8195	·8243	·8292	·8342
40	·6428	·6450	·6472	·6494	·6517	·6539	·8391	·8441	·8491	·8541	·8591	·8642
41	·6561	·6583	·6604	·6626	·6648	·6670	·8693	·8744	·8796	·8847	·8899	·8952
42	·6691	·6713	·6734	·6756	·6777	·6799	·9004	·9057	·9110	·9163	·9217	·9271
43	·6820	·6841	·6862	·6884	·6905	·6926	·9325	·9380	·9435	·9490	·9545	·9601
44	·6947	·6967	·6988	·7009	·7030	·7050	·9657	·9713	·9770	·9827	·9884	·9942

Natural Sines. Natural Tangents.

	Sines 0′	10′	20′	30′	40′	50′	Tangents 0′	10′	20′	30′	40′	50′
45°	·7071	·7092	·7112	·7133	·7153	·7173	1·000	1·006	1·012	1·018	1·023	1·029
46	·7193	·7214	·7234	·7254	·7274	·7294	1·036	1·042	1·048	1·054	1·060	1·066
47	·7314	·7333	·7353	·7373	·7392	·7412	1·072	1·079	1·085	1·091	1·098	1·104
48	·7431	·7451	·7470	·7490	·7509	·7528	1·111	1·117	1·124	1·130	1·137	1·144
49	·7547	·7566	·7585	·7604	·7623	·7642	1·150	1·157	1·164	1·171	1·178	1·185
50	·7660	·7679	·7698	·7716	·7735	·7753	1·192	1·199	1·206	1·213	1·220	1·228
51	·7771	·7790	·7808	·7826	·7844	·7862	1·235	1·242	1·250	1·257	1·265	1·272
52	·7880	·7898	·7916	·7934	·7951	·7969	1·280	1·288	1·295	1·303	1·311	1·319
53	·7986	·8004	·8021	·8039	·8056	·8073	1·327	1·335	1·343	1·351	1·360	1·368
54	·8090	·8107	·8124	·8141	·8158	·8175	1·376	1·385	1·393	1·402	1·411	1·419
55	·8192	·8208	·8225	·8241	·8258	·8274	1·428	1·437	1·446	1·455	1·464	1·473
56	·8290	·8307	·8323	·8339	·8355	·8371	1·483	1·492	1·501	1·511	1·520	1·530
57	·8387	·8403	·8418	·8434	·8450	·8465	1·540	1·550	1·560	1·570	1·580	1·590
58	·8480	·8496	·8511	·8526	·8542	·8557	1·600	1·611	1·621	1·632	1·643	1·653
59	·8572	·8587	·8601	·8616	·8631	·8646	1·664	1·675	1·686	1·698	1·709	1·720
60	·8660	·8675	·8689	·8704	·8718	·8732	1·732	1·744	1·756	1·768	1·780	1·792
61	·8746	·8760	·8774	·8788	·8802	·8816	1·804	1·816	1·829	1·842	1·855	1·868
62	·8829	·8843	·8857	·8870	·8884	·8897	1·881	1·894	1·907	1·921	1·935	1·949
63	·8910	·8923	·8936	·8949	·8962	·8975	1·963	1·977	1·991	2·006	2·020	2·035
64	·8988	·9001	·9013	·9026	·9038	·9051	2·050	2·065	2·081	2·096	2·112	2·128
65	·9063	·9075	·9088	·9100	·9112	·9124	2·144	2·161	2·178	2·194	2·211	2·229
66	·9135	·9147	·9159	·9171	·9182	·9194	2·246	2·264	2·282	2·300	2·318	2·337
67	·9205	·9216	·9228	·9239	·9250	·9261	2·356	2·375	2·394	2·414	2·434	2·454
68	·9272	·9283	·9293	·9304	·9315	·9325	2·475	2·496	2·517	2·539	2·560	2·583
69	·9336	·9346	·9356	·9367	·9377	·9387	2·605	2·628	2·651	2·675	2·699	2·723
70	·9397	·9407	·9417	·9426	·9436	·9446	2·747	2·773	2·798	2·824	2·850	2·877
71	·9455	·9465	·9474	·9483	·9492	·9502	2·904	2·932	2·960	2·989	3·018	3·047
72	·9511	·9520	·9528	·9537	·9546	·9555	3·078	3·108	3·140	3·172	3·204	3·237
73	·9563	·9572	·9580	·9588	·9596	·9605	3·271	3·305	3·340	3·376	3·412	3·450
74	·9613	·9621	·9628	·9636	·9644	·9652	3·487	3·526	3·566	3·606	3·647	3·689
75	·9659	·9667	·9674	·9681	·9689	·9696	3·732	3·776	3·821	3·867	3·914	3·962
76	·9703	·9710	·9717	·9724	·9730	·9737	4·011	4·061	4·113	4·165	4·219	4·275
77	·9744	·9750	·9757	·9763	·9769	·9775	4·331	4·390	4·449	4·511	4·574	4·638
78	·9781	·9787	·9793	·9799	·9805	·9811	4·705	4·773	4·843	4·915	4·989	5·066
79	·9816	·9822	·9827	·9833	·9838	·9843	5·145	5·226	5·309	5·396	5·485	5·076
80	·9848	·9853	·9858	·9863	·9868	·9872	5·671	5·769	5·871	5·976	6·084	6·197
81	·9877	·9881	·9886	·9890	·9894	·9899	6·314	6·435	6·561	6·691	6·827	6·968
82	·9903	·9907	·9911	·9914	·9918	·9922	7·115	7·269	7·429	7·596	7·770	7·953
83	·9925	·9929	·9932	·9936	·9939	·9942	8·144	8·345	8·556	8·777	9·010	9·255
84	·9945	·9948	·9951	·9954	·9957	·9959	9·514	9·788	10·08	10·39	10·71	11·06
85	·9962	·9964	·9967	·9969	·9971	·9974	11·43	11·83	12·25	12·71	13·20	13·73
86	·9976	·9978	·9980	·9981	·9983	·9985	14·30	14·92	15·60	16·35	17·17	18·07
87	·9986	·9988	·9989	·9990	·9902	·9993	19·08	20·21	21·47	22·90	24·54	26·43
88	·9994	·9995	·9296	·9997	·9997	·9998	28·64	31·24	34·37	38·19	42·96	49·10
89	·9998	·9999	·9999				57·29	68·75	85·94	114·6	171·9	343·8

HYDROMETRIC TABLES.

The *Twaddell Hydrometer*, generally employed in England, has a scale of from 0° to 200°, corresponding to change in Specific Gravity from 1 to 2, the degrees representing constant increases. Water at 4°C. is considered to have a Specific Gravity of 1000, hence an increase in Specific Gravity of 5 units corresponds to an increase of 1° Tw.

Conversion of degrees Twaddell to Specific Gravity.

$$\text{Specific Gravity} = 1 + \frac{5(^\circ\text{Tw.})}{1000}$$

The *original* Beaumé Hydrometer Scale is graduated so that 0° is at the point to which the hydrometer sinks in a 10 per cent. solution of sodium chloride, and 10° at the point to which it sinks in water, both liquids being at 17·5°C.

The *continental* Beaumé Hydrometer has the rational scale proposed by Lunge, in which 0° is the point to which it sinks in water and 10° the point to which it sinks in a 10% solution of sodium chloride, both liquids being at 12·5°C.

Conversion of degrees Baumé (heavier than water) to Specific Gravity.

Baumé "Rational" Scale.

Specific Gravity at 15°C. (compared to water at 15°C.=1)= $\frac{144.3}{144.3-n}$ where n = °Bé.

°Bé.	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°
–	1.000	1.007	1.014	1.021	1.029	1.036	1.043	1.051	1.059	1.066
10	1.074	1.082	1.091	1.099	1.107	1.116	1.125	1.134	1.143	1.152
20	1.161	1.170	1.180	1.190	1.200	1.210	1.220	1.230	1.241	1.251
30	1.262	1.274	1.285	1.296	1.308	1.320	1.332	1.345	1.357	1.370
40	1.384	1.397	1.411	1.424	1.439	1.453	1.468	1.483	1.498	1.514
50	1.530	1.547	1.563	1.580	1.598	1.616	1.634	1.652	1.672	1.692
60	1.712	1.732	1.753	1.775	1.797	1.820	1.843	1.867	1.891	1.916

Conversion of degrees Baumé to degrees Twaddell.

°Bé.	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°
-	0	1.4	2.8	4.4	5.8	7.4	9.0	10.4	12.0	13.4
10	15.0	16.6	18.2	20.0	21.6	23.2	25.0	26.8	28.4	30.4
20	32.4	34.2	36.0	38.0	40.0	42.0	44.0	46.2	48.2	50.4
30	52.6	54.8	57.0	59.4	61.6	64.0	66.4	69.0	71.4	74.0
40	76.6	79.4	82.0	84.8	87.6	90.6	93.6	96.6	99.6	103.0
50	106.0	109.2	112.6	116.0	119.4	123.0	127.0	130.4	134.2	138.2
60	142.0	146.4	150.6	155.0	159.0	164.0	168.4	173.0	178.2	183.2

Conversion of degrees Twaddell to degrees Baumé.

Tw.	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°
—	0	0.7	1.4	2.1	2.7	3.4	4.1	4.7	5.4	6.0
10	6.7	7.4	8.0	8.7	9.4	10.0	10.6	11.2	11.9	12.4
20	13.0	13.6	14.2	14.9	15.4	16.0	16.5	17.1	17.7	18.3
30	18.8	19.3	19.8	20.3	20.9	21.4	22.0	22.5	23.0	23.5
40	24.0	24.5	25.0	25.5	26.0	26.4	26.9	27.4	27.9	28.4
50	28.8	29.3	29.7	30.2	30.6	31.1	31.5	32.0	32.4	32.8
60	33.3	33.7	34.2	34.6	35.0	35.4	35.8	36.2	36.6	37.0
70	37.4	37.8	38.2	38.6	39.0	39.4	39.8	40.1	40.5	40.8
80	41.2	41.6	42.0	42.3	42.7	43.1	43.4	43.8	44.1	44.4
90	44.8	45.1	45.4	45.8	46.1	46.4	46.8	47.1	47.4	47.8
100	48.1	48.4	48.7	49.0	49.4	49.7	50.0	50.3	50.6	50.9
110	51.2	51.5	51.8	52.1	52.4	52.7	53.0	53.3	53.6	53.9
120	54.1	54.4	54.7	55.0	55.2	55.5	55.8	56.0	56.3	56.6
130	56.9	57.1	57.4	57.7	57.9	58.2	58.4	58.7	58.9	59.2
140	59.5	59.7	60 0	60.2	60.4	60.6	60.9	61.1	61.4	61.6
150	61.8	62.1	62.3	62.5	62.8	63.0	63.2	63.5	63.7	64.0
160	64.2	64.4	64.6	64.8	65.0	65.2	65.5	65.7	65.9	66.1
170	66.3	66.5	66.7	67.0	67.1	67.3	67.5	67.8	68.0	68.2

Conversion of degrees Baumé (lighter than water) to Specific Gravity.

°Bé	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°
-10	1.000	0.993	0.986	0.980	0.973	0.967	0.960	0.954	0.948	0.942
-20	0.936	0.930	0.924	0.918	0.913	0.907	0.901	0.896	0.890	0.885
-30	0.880	0.874	0.869	0.864	0.859	0.854	0.849	0.844	0.839	0.834
-40	0.830	0.825	0.820	0.816	0.811	0.807	0.802	0.798	0.794	0.789
-50	0.785	0.781	0.777	0.773	0.768	0.764	0.760	0.757	0.753	0.749

The American Standard Beaumé Scale, adopted by the Manufacturing Chemists' Association of the United States, is calculated from the following formulæ :—

For liquids heavier than water at 60°F. (=15·55°C.),

$$°Bé = 145 - \frac{145}{Sp.\ Gr.}\ ;\quad \text{Specific Gravity} = \frac{145}{°Bé - 145}$$

For liquids lighter than water,

$$°Bé = \frac{140}{Sp.\ Gr.} - 130\ ;\quad \text{Specific Gravity} = \frac{140}{130 + °Bé}.$$

Conversion of American degrees Beaumé (lighter than water) to Specific Gravity.

°Bé	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°
10	1.000	0.993	0.986	0.979	0.972	0.966	0.959	0.952	0.946	0.940
20	0.933	0.927	0.921	0.915	0.909	0.903	0.897	0.892	0.886	0.880
30	0.875	0.870	0.864	0.859	0.854	0.848	0.843	0.838	0.833	0.828
40	0.824	0.819	0.814	0.809	0.804	0.800	0.795	0.791	0.786	0.782
50	0.778	0.773	0.769	0.765	0.761	0.757	0.753	0.749	0.745	0.741
60	0.737	0.733	0.729	0.725	0.722	0.718	0.714	0.711	0.707	0.704
70	0.700	0.696	0.693	0.690	0.686	0.683	0.680	0.676	0.673	0.670
80	0.667	0.664	0.660	0.657	0.654	0.651	0.648	0.645	0.642	0.639
90	0.636	0.633	0.631	0.628	0.625	0.622	0.619	0.617	0.614	0.611

Conversion of degrees Centigrade to degrees Fahrenheit and degrees Réaumur.

Cent.	Fahr.	Réaumur.	Cent.	Fahr.	Réaumur.
-40	-40	-32	+14	+57.2	+11.2
39	38.2	31.2	15	59	12
38	36.4	30.4	16	60.8	12.8
37	34.6	29.6	17	62.6	13.6
36	32.8	28.8	18	64.4	14.4
35	31	28	19	66.2	15.2
34	29.2	27.2	20	68	16
33	27.4	26.4	21	69.8	16.8
32	25.6	25.6	22	71.6	17.6
31	23.8	24.8	23	73.4	18.4
30	22	24	24	75.2	19.2
29	20.2	23.2	25	77	20
28	18.4	22.4	26	78.8	20.8
27	16.6	21.6	27	80.6	21.6
26	14.8	20.8	28	82.4	22.4
25	13	20	29	84.2	23.2
24	11.2	19.2	30	86	24
23	9.4	18.4	31	87.8	24.8
22	7.6	17.6	32	89.6	25.6
21	5.8	16.8	33	91.4	26.4
20	4	16	34	93.2	27.2
19	2.2	15.2	35	95	28
18	0.4	14.4	36	96.8	28.8
17	+1.4	13.6	37	98.6	29.6
16	3.2	12.8	38	100.4	30.4
15	5	12	39	102.2	31.2
14	6.8	11.2	40	104	32
13	8.6	10.4	41	105.8	32.8
12	10.4	9.6	42	107.6	33.6
11	12.2	8.8	43	109.4	34.4
10	14	8	44	111.2	35.2
9	15.8	7.2	45	113	36
8	17.6	6.4	46	114.8	36.8
7	19.4	5.6	47	116.6	37.6
6	21.2	4.8	48	118.4	38.4
5	23	4	49	120.2	39.2
4	24.8	3.2	50	122	40
3	26.6	2.4	51	123.8	40.8
2	28.4	1.6	52	125.6	41.6
1	30.2	0.8	53	127.4	42.4
0	32	0	54	129.2	43.2
+1	33.8	+0.8	55	131	44
2	35.6	1.6	56	132.8	44.8
3	37.4	2.4	57	134.6	45.6
4	39.2	3.2	58	136.4	46.4
5	41	4	59	138.2	47.2
6	42.8	4.8	60	140	48
7	44.6	5.6	61	141.8	48.8
8	46.4	6.4	62	143.6	49.6
9	48.2	7.2	63	145.4	50.4
10	50	8	64	147.2	51.2
11	51.8	8.8	65	149	52
12	53.6	9.6	66	150.8	52.8
13	55.4	10.4	67	152.6	53.6

Cent.	Fahr.	Réaumur.	Cent.	Fahr.	Réaumur.
68	154.4	54.4	85	185	68
69	156.2	55.2	86	186.8	68.8
70	158	56	87	188.6	69.6
71	159.8	56.8	88	190.4	70.4
72	161.6	57.6	89	192.2	71.2
73	163.4	58.4	90	194	72
74	165.2	59.2	91	195.8	72.8
75	167	60	92	197.6	73.6
76	168.8	60.8	93	199.4	74.4
77	170.6	61.6	94	201.2	75.2
78	172.4	62.4	95	203	76
79	174.2	63.2	96	204.8	76.8
80	176	64	97	206.6	77.6
81	177.8	64.8	98	208.4	78.4
82	179.6	65.6	99	210.2	79.2
83	181.4	66.4	100	212	80
84	183.2	67.2			

Conversion of degrees Fahrenheit to degrees Centigrade and degrees Réaumur.

Fahr.	Cent.	Réaumur.	Fahr.	Cent.	Réaumur.
-40	-40	-32	-13	-25	-20
39	39.44	31.56	12	24.44	19.56
38	38.89	31.11	11	23.89	19.11
37	38.33	30.67	10	23.33	18.67
36	37.78	30.22	9	22.78	18.22
35	37.22	29.78	8	22.22	17.78
34	36.67	29.33	7	21.67	17.33
33	36.11	28.89	6	21.11	16.89
32	35.55	28.44	5	20.55	16.44
31	35	28	4	20	16
30	34.44	27.56	3	19.44	15.56
29	33.89	27.11	2	18.89	15.11
28	33.33	26.67	1	18.33	14.67
27	32.78	26.22	0	17.78	14.22
26	32.22	25.78	+1	17.22	13.78
25	31.67	25.33	2	16.67	13.33
24	31.11	24.89	3	16.11	12.89
23	30.56	24.44	4	15.55	12.44
22	30	24	5	15	12
21	29.44	23.56	6	14.44	11.56
20	28.89	23.11	7	13.89	11.11
19	28.33	22.67	8	13.33	10.67
18	27.78	22.22	9	12.78	10.22
17	27.22	21.78	10	12.22	9.78
16	26.67	21.33	11	11.67	9.33
15	26.11	20.89	12	11.11	8.89
14	25.55	20.44	13	10.55	8.44

Fahr.	Cent.	Réaumur.	Fahr.	Cent.	Réaumur.
+14	−10	−8	+70	+21.11	+16.89
15	9.44	7.56	71	21.67	17.33
16	8.89	7.11	72	22.22	17.78
17	8.33	6.67	73	22.78	18.22
18	7.78	6.22	74	23.33	18.67
19	7.22	5.78	75	23.89	19.11
20	6.67	5.33	76	24.44	19.56
21	6.11	4.89	77	25	20
22	5.56	4.44	78	25.56	20.44
23	5	4	79	26.11	20.89
24	4.44	3.56	80	26.67	21.33
25	3.89	3.11	81	27.22	21.78
26	3.33	2.67	82	27.78	22.22
27	2.78	2.22	83	28.33	22.67
28	2.22	1.78	84	28.89	23.11
29	1.67	1.33	85	29.44	23.56
30	1.11	0.89	86	30	24
31	0.56	0.44	87	30.56	24.44
32	0	0	88	31.11	24.89
33	+0.56	+0.44	89	31.67	25.33
34	1.11	0.89	90	32.22	25.78
35	1.67	1.33	91	32.78	26.22
36	2.22	1.78	92	33.33	26.67
37	2.78	2.22	93	33.89	27.11
38	3.33	2.67	94	34.44	27.56
39	3.89	3.11	95	35	28
40	4.44	3.56	96	35.56	28.44
41	5	4	97	36.11	28.89
42	5.56	4.44	98	36.67	29.33
43	6.11	4.89	99	37.22	29.78
44	6.67	5.33	100	37.78	30.22
45	7.22	5.78	101	38.33	30.67
46	7.78	6.22	102	38.89	31.11
47	8.33	6.67	103	39.44	31.56
48	8.89	7.11	104	40	32
49	9.44	7.56	105	40.56	32.44
50	10	8	106	41.11	32.89
51	10.56	8.44	107	41.67	33.33
52	11.11	8.89	108	42.22	33.78
53	11.67	9.33	109	42.78	34.22
54	12.22	9.78	110	43.33	34.67
55	12.78	10.22	111	43.89	35.11
56	13.33	10.67	112	44.44	35.56
57	13.89	11.11	113	45	36
58	14.44	11.56	114	45.56	36.44
59	15	12	115	46.11	36.89
60	15.56	12.44	116	46.67	37.33
61	16.11	12.89	117	47.22	37.78
62	16.67	13.33	118	47.78	38.22
63	17.22	13.78	119	48.33	38.67
64	17.78	14.22	120	48.89	39.11
65	18.33	14.67	121	49.44	39.56
66	18.89	15.11	122	50	40
67	19.44	15.56	123	50.56	40.44
68	20	16	124	51.11	40.89
69	20.56	16.44	125	51.67	41.33

Fahr.	Cent.	Réaumur.	Fahr.	Cent.	Réaumur.
+126	+52.22	+41.78	+170	+76.67	+61.33
127	52.78	42.22	171	77.22	61.78
128	53.33	42.67	172	77.78	62.22
129	53.89	43.11	173	78.33	62.67
130	54.44	43.56	174	78.89	63.11
131	55	44	175	79.44	63.56
132	55.55	44.44	176	80	64
133	56.11	44.89	177	80.55	64.44
134	56.67	45.33	178	81.11	64 89
135	57.22	45.78	179	81.67	65.33
136	57.78	46.22	180	82.22	65.78
137	58.33	46.67	181	82.78	66.22
138	58.89	47.11	182	83.33	66.67
139	59.44	47.56	183	83.89	67.11
140	60	48	184	84.44	67.56
141	60.55	48.44	185	85	68
142	61.11	48.89	186	85.55	68.44
143	61.67	49.33	187	86.11	68.89
144	62.22	49.78	188	86.67	69.33
145	62.78	50.22	189	87.22	69.78
146	63.33	50.67	190	87.78	70.22
147	63.89	51.11	191	88.33	70.67
148	64.44	51.56	192	88.89	71.11
149	65	52	193	89.44	71.56
150	65.55	52.44	194	90	72
151	66.11	52.89	195	90.55	72.44
152	66.67	53.33	196	91.11	72.89
153	67.22	53.78	197	91.67	73.33
154	67.78	54.22	198	92.22	73.78
155	68.33	54.67	199	92.78	74.22
156	68.89	55.11	200	93.33	74.67
157	69.44	55.56	201	93.89	75.11
158	70	56	202	94.44	75.56
159	70.55	56.44	203	95	76
160	71.11	56.89	204	95.55	76.44
161	71.67	57.33	205	96.11	76.89
162	72.22	57.78	206	96.67	77.33
163	72.78	58.22	207	97.22	77.78
164	73.33	58.67	208	97.78	78.22
165	73.89	59.11	209	98.33	78.67
166	74.44	59.56	210	98.89	79.11
167	75	60	211	99.44	79.56
168	75.55	60.44	212	100	80
169	76.11	60.89			

Cent.	Fahr.	Cent.	Fahr.	Cent.	Fahr.
105	221	140	284	175	347
110	230	145	293	180	356
115	239	150	302	185	365
120	248	155	311	190	374
125	257	160	320	200	392
130	266	165	329	250	482
135	275	170	338	300	572

Conversion of degrees Réaumur to degrees Fahrenheit and degrees Centigrade.

Réaumur.	Fahr.	Cent.	Réaumur.	Fahr.	Cent.
-32	-40	-40	+25	+88.25	+31.25
31	37.75	38.75	26	90.50	32.50
30	35.50	37.50	27	92.75	33.75
29	33.25	36.25	28	95	35
28	31	35	29	97.25	36.25
27	28.75	33.75	30	99.50	37.50
26	26.50	32.50	31	101.75	38.75
25	24.25	31.25	32	104	40
24	22	30	33	106.25	41.25
23	19.75	28.75	34	108.50	42.50
22	17.50	27.50	35	110.75	43.75
21	15.25	26.25	36	113	45
20	13	25	37	115.25	46.25
19	10 75	23.75	38	117.50	47.50
18	8.50	22.50	39	119.75	48.75
17	6.25	21.25	40	122	50
16	4	20	41	124.25	51.25
15	1.75	18.75	42	126.50	52.50
14	+0.50	17.50	43	128.75	53.75
13	2.75	16.25	44	131	55
12	5	15	45	133.25	56.25
11	7.25	13.75	46	135.50	57.50
10	9.50	12.50	47	137.75	58.75
9	11.75	11.25	48	140	60
8	14	10	49	142.25	61.25
7	16.25	8.75	50	144.50	62.50
6	18.50	7.50	51	146.75	63.75
5	20.75	6.25	52	149	65
4	23	5	53	151.25	66.25
3	25.25	3.75	54	153.50	67.50
2	27.50	2.50	55	155.75	68.75
1	29.75	1.25	56	158	70
0	32	0	57	160.25	71.25
+1	34.25	+1.25	58	162.50	72.50
2	36.50	2.50	59	164.75	73.75
3	38.75	3.75	60	167	75
4	41	5	61	169.25	76.25
5	43.25	6.25	62	171.50	77.50
6	45.50	7.50	63	173.75	78.75
7	47.75	8.75	64	176	80
8	50	10	65	178.25	81.25
9	52.25	11.25	66	180.50	82.50
10	54.50	12.50	67	182.75	83.75
11	56.75	13.75	68	185	85
12	59	15	69	187.25	86.25
13	61.25	16.25	70	189.50	87.50
14	63.50	17.50	71	191.75	88.75
15	65.75	18.75	72	194	90
16	68	20	73	196.25	91.25
17	70.25	21.25	74	198.50	92.50
18	72.50	22.50	75	200.75	93.75
19	74.75	23.75	76	203	95
20	77	25	77	205.25	96.25
21	79.25	26.25	78	207.50	97.50
22	81.50	27.50	79	209.75	98.75
23	83.75	28.75	80	212	100
24	86	30			

Barometer Readings.

CONVERSION OF INCHES INTO MILLIMETRES OF MERCURY.

in.	0	1	2	3	4	5	6	7	8	9
29.0	736.59	736.85	737.10	737.36	737.61	737.86	738.12	738.37	738.63	738.88
29.1	739.13	739.39	739.64	739.90	740.15	740.40	740.66	740.91	741.17	741.42
29.2	741.67	741.93	742.18	742.44	742.69	742.94	743.20	743.45	743.71	743.96
92.3	744.21	744.47	744.72	744.98	745.23	745.48	745.74	745.99	746.25	746.50
29.4	746.75	747.01	747.26	747.52	747.77	748.02	748.27	748.53	748.78	749.04
29.5	749.29	749.55	749.80	750.06	750.31	750.56	750.82	751.07	751.33	751.58
29.6	751.83	752.09	752.34	752.60	752.85	753.10	753.36	753.61	753.87	754.12
29.7	754.37	754.63	754.88	755.14	755.39	755.64	755.90	756.15	756.41	756.65
29.8	756.91	757.17	757.42	757.68	757.93	758.18	758.44	758.69	758.95	759.20
29.9	759.45	759.71	759.96	760.22	760.47	760.72	760.98	761.23	761.49	761.74
30.0	761.99	762.25	762.50	762.76	763.01	763.26	763.52	763.77	764.03	764.28
30.1	764.53	764.79	765.04	765.30	765.55	765.80	766.06	766.31	766.57	766.82
30.2	767.07	767.33	767.58	767.84	768.09	768.34	768.60	768.85	769.11	769.36
30.3	769.61	769.87	770.12	770.38	770.63	770.88	771.14	771.39	771.65	771.90
30.4	772.15	772.41	772.66	772.92	773.17	773.42	773.68	773.93	774.19	774.44
30.5	774.69	774.95	775.20	775.46	775.71	775.96	776.22	776.47	776.73	776.98
30.6	777.23	777.49	777.74	778.00	778.25	778.50	778.76	779.01	779.27	779.52
30.7	779.77	780.03	780.28	780.54	780.79	781.04	781.30	781.55	781.81	782.06
30.8	782.31	782.57	782.82	783.08	783.33	783.58	783.84	784.09	784.35	784.60
30.9	784.85	785.11	785.36	785.62	785.87	786.12	786.38	786.63	786.89	787.14
31.0	787.39	787.65	787.90	788.16	788.41	788.66	788.82	789.17	789.43	789.68

CONVERSION OF MILLIMETRES INTO INCHES OF MERCURY.

mm.	0	1	2	3	4	5	6	7	8	9
700	27.56	27.60	27.64	27.68	27.72	27.76	27.80	27.84	27.88	27.91
710	27.95	27.99	28.03	28.07	28.11	28.15	28.19	28.23	28.27	28.31
720	28.35	28.39	28.43	28.47	28.50	28.54	28.58	28.62	28.66	28.70
730	28.74	28.78	28.82	28.86	28.90	28.94	28.98	29.02	29.06	29.10
740	29.13	29.17	29.21	29.25	29.29	29.33	29.37	29.41	29.45	29.49
750	29.53	29.57	29.61	29.65	29.69	29.73	29.77	29.80	29.84	29.88
760	29.92	29.96	30.00	30.04	30.08	30.12	30.16	30.20	30.24	30.28
770	30.32	30.36	30.39	30.43	30.47	30.51	30.55	30.59	30.63	30.67
780	30.71	30.75	30.79	30.83	30.87	30.91	30.95	30.99	31.02	31.06